IMPACT OF MASTERY LEARNING APPROACH ON MOTIVATION AND PERFORMANCE IN WAVE CONCEPTS AMONG SENIOR SECONDARY SCHOOL PHYSICS STUDENTS IN ZARIA, KADUNA, NIGERIA

BY

Mustapha Bichi, SANI

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FACULTY OF EDUCATION,

AHMADU BELLO UNIVERSITY,

ZARIA. NIGERIA

OCTOBER, 2018

DECLARATION

I hereby declare that the work in this dissertation entitled "**IMPACT OF MASTERY LEARNING APPROACH ON MOTIVATION AND PERFORMANCE IN WAVE CONCEPTS AMONG SENIOR SECONDARY SCHOOL PHYSICS STUDENTS IN ZARIA, KADUNA STATE, NIGERIA"** has been carried out by Mustapha Bichi SANI, P14EDSC8012 in the Department of Science Education, Ahmadu Bello University, Zaria. The information derived from the literature is duly acknowledged in the text and lists of references provided. No part of this dissertation was previously presented for another degree or diploma at any institution.

_____ _____

Mustapha Bichi SANI Date

CERTIFICATION

This dissertation entitled "**IMPACT OF MASTERY LEARNING APPROACH ON MOTIVATION AND ACADEMIC PERFORMANCE IN WAVE CONCEPTS AMONG SENIOR SECONDARY SCHOOL PHYICS STUDENTS IN ZARIA, KADUNA STATE, NIGERIA"** by Mustapha Bichi SANI, P14EDSC8012 meets the regulations governing the award of masters degree in Physics Education of the Ahmadu Bello University, Zaria, and is approved for its Contribution to knowledge and literary presentation.

_____ _____

Prof. M.M. Atadoga Date
Chairman, Supervisory Committee

_____ _____

Prof. M. A. Lakpini Date
Member, Supervisory Committee

_____ _____

Prof. S. S. Bichi Date
Head of Science Education Department

_____ _____

Prof. S. Z. Abubakar Date
Dean, School of Postgraduate Studies

DEDICATION

This work is dedicated to all Physics Teachers in Nigerian Secondary Schools.

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LIST OF ABBREVIATIONS

The following abbreviations are used in this study

IEAP: International Assessment of Educational Progress

MAN: Mathematics Association of Nigeria

MLA: Mastery Learning Approach

PAPT: Physics Academic Performance Test

RTM: Regular Teaching Method

SMQ: Student Motivation Questionnaire

STAN: Science Teachers Association of Nigeria

WAEC: West African Examination Council

OPERATIONAL DEFINITION OF TERMS

The following terms are operationally defined as used in this study.

Mastery Learning Approach: Mastery Learning Approach (MLA) is a process in which students are provided with the opportunity to master a particular unit of lesson before proceeding to the next. It divides subject matter into unit that has predetermined objectives or unit expectations, where students alone or in groups work through each unit in an organized fashion.

Motivation: Motivation is defined as a set of force that causes people to behave in certain desired or positive ways.

Performance: This refers to the extent to which a student, teacher or institution has achieved their short or long-term educational goals

Lecture Method: It is an oral presentation of information about a particular subject.

Inquiry Method: This is a method of teaching where the students, with minimum guidance from the teacher seek to discover and creates answers to a recognize problem through procedure of making a diligent search.

Discussion Method: This is a method of teaching where by the instructor typically relies on students to provide ideas, experiences, opinion and information about a particular concept.

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ABSTRACT

This study investigated the Impact of Mastery Learning Approach (MLA) on Motivation and Academic Performance in Physics among Senior Secondary School Students in Zaria, Kaduna State, Nigeria. The study comprises four objectives with their corresponding research questions and null hypotheses. The research design used was pre-test, post-test, quasi-experimental control group design. The population of the study covered all the 9 coeducational senior secondary schools (SSII) in Zaria, offering Physics with total enrolment of 304 out of which 67 from two coeducational schools were selected as sample using simple random sampling technique. Two validated instruments namely; Physics Academic Performance Test (PAPT) and Students' Motivation Questionnaire (SMQ) were used for data collection with a reliability coefficient of 0.89 and 0.76 respectively using PPMC and Cronbach's Alpha statistical tool using SPSS. Research questions raised were answered using mean and standard deviation while null hypotheses were tested using t-test and Mann-Whitney U-test at 0.05 level of significance. Results of findings reveal that there is significant difference between the performance mean scores of students taught using MLA and those taught using lecture method in favour of MLA group. Also, there is significant difference in the motivation level of students taught using MLA and those taught using lecture method in favour of the MLA group. Similarly, the findings reveal that there is no significant difference in the level of motivation of male and female students taught using MLA. From the findings of the study, the following recommendations are made: Physics teachers should be motivated and encouraged by Ministry of Education to use Science Teachers Association of Nigeria (STAN) modules for seminars and workshops on the effective use of MLA as it motivate students in teaching and learning of Physics. It is also recommended that MLA should be used to teach Physics to both male and female students at secondary school level as it was found in this study to be gender friendly.

CHAPTER ONE

THE PROBLEM

1.1 Introduction

Science is the foundation upon which the bulk of present day technological breakthrough is built. These days, developing nations all over the world including Nigeria are striving hard to develop scientifically and technologically since the world is becoming scientific and proper functioning of lives depend greatly on science. Its relevance as a requirement for technological development of a nation cannot be underrated (Philips 2002). Owolabi (2004) viewed science as an integral part of human society. Its impact is felt in every way of human life so much that it is intricately linked with a nation's development. Science as a field of study has done a lot for mankind. For instance, life has become easier for man as a result of the advancement in science. Through science, man has been able to understand his environment. For example, by drastically changing our means of communication, the way we work, our housing, clothes and food, our methods of transportation, and indeed even the length and quality of life itself, science has generated changes in the moral values and basic philosophies of mankind. According to Ogunleye (2002), science is taught as Physics, Chemistry and Biology.

Physics is one of the science subjects taught in Senior Secondary Schools. It deals with the study of the behaviour of matter in relation to energy. Physics is the most fundamental and all-inclusive of sciences and as science is considered a veritable tool widely recognized as being of great importance for the development of the economic well being of any nation, then the knowledge of Physics cannot be overemphasized (Wambugu & Changeiywo 2008). This stressed the fact that science and technology are

interwoven. Therefore the broad knowledge of science and technology is very important especially as the world today has a lot of challenges ranging from natural and artificial phenomena. It's noteworthy that today, with the extensive help of the collaborative work of scientists and technologists, the whole world is considered as a single community served by electronic media and information technology. Hence, we can say that without the fundamental knowledge of science, the actualization of the benefits that science brings to the society will only be a mirage and the figment of our imagination (Adeyemo & Babajide, 2014). Physics is one of the fundamental and all-inclusive of science; therefore, Physics teachers need to prepare well in order to present basic knowledge and understanding of its concepts.

Poor preparation of teachers, over-crowded classroom, inadequacy of laboratory and workshop facilities, poor attitude of students to work, gross under funding, inadequacy of reward for excellence in science teaching and learning has been attributed to some of the factors leading poor performance of students. Others are: misconception of some concepts, inadequacy of new teaching techniques and frequent practical classes, inadequacy of revising past question papers, and inadequacy of relating science subjects with practical situations (Adamu & Ahmad, 1999; Akubuilo, 2004; WAEC 2005; Lawal, 2009). It is very important to note that for effective learning to take place, necessary teaching and learning techniques, quality instructions, evaluation, feedback and instructional materials should be rightly put in place as humans tend to learn better by hearing, seeing and doing rather than reading. Therefore, it is important that the use of well defined instructional materials that aid pedagogy and learning process should be employed while teaching especially difficult subject in Physics.

Research reports by Ajayi (2007), Adedayo (2008) and Adeyemo (2010) revealed that the performance of students in Physics is very appalling, hence, call for attention towards generating effort towards improving the situation. The report of West African Examination Council (WAEC, 2014) contains worries over the low performance of students in Physics. The WAEC Chief Examiner's report stated that 70% of candidates that sat for the Physics examination in the year 2014/2015 session failed the subject. Poor performance in Physics could be attributed to many factors ranging from the attitude of students towards the subject, lack of motivation on the part of the students, lack of basic science background at the primary school and teachers' strategy which is considered as an important factor (Owolabi, 2004; Omebe & Akani, 2015).

Nigeria secondary school students are taught Physics by "chalk and talk" lecture method have repeatedly demonstrated poor motivation and low performance in and from their Physics education programme. Lecture method is an oral presentation of information about a particular subject (Joe, 2011). It is often used to deliver a large amount of information to the students in a short period (Berry, 2008). It is designed to deliver new information to a large group of students. It is also known to be effective in dealing with a large class. Regrettably, most science teachers in a bid to cover their syllabus adopt lecture method (Ali & Akubue, 1998). Lecture method is mainly teachers centered and subject driven (Liddle, 2002). It does not encourage initiatives, curiosity, and creativity in learners and does not offer them opportunity to interact effectively with their peers and learning materials. This has resulted in students' loss of interest, reduced participation and poor learning performance.

Educators are incessantly concerned about the need to improve students' academic performance especially in the sciences. The plethora of research on students' academic performance in the science is a testimony to this concern (Ayot & Petal, 1987; Lee, 2004; Wilson, 2004; Samuel, 2007; Olatoye, Aderogba & Aanu, 2011). The issue of teaching methods and their effect on secondary school students' performance has been a very important issue in recent times. It is apparent that science and technology cannot thrive without using the appropriate instructional strategies to teach the students. The future development of any nation in the field of science depends on how well the subjects are taught which require that students are able master what they are taught.

Mastery Learning Approach (MLA) is a process in which learners are provided with the opportunity to master a particular unit of lesson before proceeding to the next. Most modern applications of mastery learning stem from the writing of Bloom (1968) even though the idea of the approach dated back to earlier years. Bloom (1968) hypothesized that a classroom with a mastery learning focus as opposed to the traditional form of instruction would reduce the performance gaps between learners of varying degrees of academic abilities (Guskey, 2007). Mastery Learning Approach divides subject matter into unit that has predetermined objectives or unit expectations where students alone or in groups work through each unit in an organized fashion. The teacher assesses and grades the students after each unit to determine who has mastered the content and who needs more help. Students must demonstrate mastery on unit exams typically 80% before moving on to new material (Davis & Sorrell, 1995; Anderson, 2000). Students who have mastered the materials are given enrichment opportunities which could be in the form of projects or problem solving tasks. Students, who do not achieve mastery received

remediation through torturing, peer monitoring, small group discussions or additional assignment. Additional time for learning is prescribed for those requiring remediation and students continue the cycle of studying and testing until mastery is achieved after which they can proceed to more advanced learning tasks. Mastery Learning Approach is learner center-centered, making learners' active participants of the learning task and also motivated to learn.

Motivation is defined as a set of force that causes people to behave in certain ways. It is a set of force that changes behaviour and determine it form; direction and intensity. Motivation is that energizing force that induces or compels and maintain behaviour. There are two types of motivation in learning process. These are extrinsic and intrinsic motivation. Extrinsic motivation is directed at earning rewards that are external to a learner, while intrinsic motivation is doing something because it is inherently interesting or enjoyable (Deci & Ryan, 1985). Hancock (2004) asserts that a motivated learner performs well. The teaching approach a teacher adopts is a strong factor that may affect students' motivation toward learning, which in turn affects their performance. Motivation can be enhanced through teaching methods that actively involve students (Keraro, Wachanga & Orora 2006). Students are categorized as academically motivated when they are able to maintain high ability, and competence in their work. How the teachers view motivation will influence what they should do to establish a classroom environment that will enhance students' motivation (Dembo, 1994). A teacher has the ability to influence the students' motivation to learn through a variety of teaching decisions and approaches (Shihusa & Kerora, 2009).

According to Hohn (1995), there is need for classroom practices that would arouse the students' interest and attention, raise their expectancies of success in academic work and give them incentives and rewards that they value. A teaching method that would help students to find satisfaction in the subject matter and also make the subject matter relevant to the need of the learner will be necessary to motivate them. Keller's attention, relevance, confidents and satisfaction (ARCS) model (Hohn, 1995) can be used to enhance students' motivation to learn. Most of the tasks found in Physics course that a student is required to perform are not inherently interesting or enjoyable. There is need for a teaching strategy that will promote more active and volitional form of extrinsic motivation (Ryan & Deci, 2000). Early study had shown that positive performance feedback enhanced intrinsic motivation (Deci, 1971). Consequently, a teaching approach that has continuous feedback to the performance of students can motivate students to value and self-regulate the academic activities, and eager to carry them out on their own.

The issue of gender is an important issue of discuss in science education especially with increasing emphasis on ways of boosting manpower for technological development as well as increasing the population of females in science education and technology fields (Ogunkola & Bilesman-Awoderu, 2000). In Nigeria, and perhaps the whole of Africa, gender bias is still very prevalent (Arigbabu & Mji, 2004). This is a view to which Onyeizugbo (2003) has also alluded in pointing out that "sex roles are held rigid in Africa particularly in Nigeria where gender differences are highly emphasized". It is common place to see gender stereotypes manifested in the day- to-day life of an average Nigeria. Certain vocations and professions have been traditionally regarded as men's course (medicine, engineering, architecture) and others as women's course (nursing, catering,

typing, and arts). What are regarded as complex and difficult tasks are allocated to boys, whereas girls are expected to handle relatively easy and less demanding tasks. As a result, the larger society tends to see girls as the "weaker sex". Consequently, an average Nigerian child goes to school with these fixed stereotypes. Gender issues, both on the part of the teachers and students, have been documented to affect performance generally (Kennedy, 2000 & Erinosho, 2005). Conflicting results in gender- related research vary in their learning contexts and outcomes. These include the methodology, population, geography, research tasks and classroom settings. Girls are being encouraged today and sensitized to develop positive attitudes towards science. However, some researchers still found that there are still significant differences in the cognitive, affective, and psychomotor skills performance of students' in respect of gender (Billing, 2000; Croxford, 2003; Kolawole, 2007; Aguele & Agwugah, 2007). Thus, the issue of gender in science education is yet to be concluded. Therefore, it is on this basis that this research sought to find out the Impact of Mastery Learning Approach on Motivation and Performance in Wave Concepts among Senior Secondary School Physics Students in Zaria, Kaduna State, Nigeria.

1.1.1 Theoretical Framework

The concept of mastery learning is rooted in the behaviorism principles of operant conditioning (Skinner, 1984). According to operant conditioning theory, learning occurs when an association is formed between a stimulus and response. In line with the behaviour theory, mastery learning focuses on overt behaviours that can be observed and measured (Baum, 2005). Mastery learning as a theoretical approach goes back to the work of Bloom (1968) who came up with "learning for mastery" method. Bloom was

interested on how he could improve traditional classroom instruction by examining what it was about individual tutoring that made it an effective instructional approach. Bloom contended that most instructors divide their instructional materials into smaller units of instruction, but the way the students' progress as assessed was not helpful for their learning. He observed that instructors typically had the students take an assessment at the end of the instruction, which served to give the students a grade for their performance, but regardless of how the students did, he or she continued on into the next unit of instruction not minding his or her grade.

Bloom recommended that the material to be learned be divided first into instructional units, similar to the way the chapters are organized in a course textbook. Following a teacher's initial instruction in each unit, a formative assessment or quiz is administered not as a part of the grading process, but to provide feedback to both the students and teacher about what material was learned well and what was not. Special correctives are then offered to students who require additional time and practice to learn the material. For those who have learned the material well, special enrichment activities are planned to give them opportunities to strengthen and extend their learning. Following the correctives work, a second formative assessment is administered to verify students' success. Typically, corrective activities are made specific to each learning unit so that each student needs to work on only those concepts or skills that he or she has not yet mastered. The results from the formative assessment provide the students with a specific prescription for what more needs to be done to master the unit's learning objectives. The activities are designed to present the material differently and involve the student in alternative methods to learn the material. The corrections may be worked on with the teacher, peers in

cooperative learning teams or by the student independently (Guskey, 1986). The formative assessment process combined with systematic corrections of individual learning difficulties provides each student with a more appropriate quality of instruction than is possible under more traditional approaches to classroom teaching. Using this approach according to Bloom, virtually all students could master the subject (Bloom, 1976).

Mastery learning as a school of thought presumes that all children can learn if they are provided with the appropriate learning conditions. In mastery learning, students are assisted by the teachers to master each learning unit before proceeding to the next which is more advanced. This instructional philosophy is based on the belief that all learners can learn if given the appropriate amount of time and the appropriate instructional opportunities. Three basic indicators of learning output could be identified in the work of Bloom (1984). These are cognitive introduction behaviors (i.e. preliminary learning which is assumed to be a necessary pre-requisite for learning a concept); emotional introduction features (the extent of learners' motivation to learn); and the quality of teaching activity. The variables (clues, reinforcement, students' participation, feedback and correction) which Bloom described as the quality of teaching activity, explain the activities which are prepared by the teacher to enable mastery learning. According to this theory, if related introduction features of the students along with the teaching activities are positive, the learning output will reach a high level and the differentiation between the students in terms of performance will be at a minimum level (Sever, 1997). In other words, the theoretical framework of this research is based on Bloom's Learning for Mastery.

1.2 Statement of the Problem

Students' failure in senior secondary school West African Examination Council (WAEC) is becoming the order of the day in which only few candidates obtained the requirements for further studies into Nigerian Higher Institutions. The percentage of failure recorded in Physics for the past eight years ranged from 75.06% in 2010, 44.66% in 2011, 61.19% in 2012, 35.74% in 2013, 70% in 2014, 37.96% in 2015, 19.96% in 2016 and 31.23% in 2017(WAEC). Besides Physics, as one of the science subjects remains one of the most difficult subjects in school curriculum (Isolo, 2010). Also most of the students consider the concept involved in the study of Physics to be too abstract and difficult to understand. This may account for the current low students' performance, motivation and enrolment in the subject. Several studies have investigated the causes of the appalling state of Physics performance. These causes were identified as: low students motivation to learn Physics, poor teaching approaches used by Physics teachers, teachers use of language in the classrooms, perceived difficulty of the subject and inadequate instructional materials (Ndirangu,2000; Kiboss, 2002; Etikna, 2005; & Oyoo, 2009). Students shun sciences particularly Physics when given an option and this applies to girls (Aduda, 2003). That is if given a choice, students would rather drop Physics in favor of other science subjects. Physics has been mystified as a difficult subject by most students. Recent findings show that students who hold negative stereotype images of scientists, science, and technology in society are easily discouraged from pursuing scientific disciplines and usually performed poorly in science subjects (Changeiywo, 2000).

The teaching of Physics in Nigeria has predominantly been through lecture method, which has been implicated to bring about poor academic performance and low motivation

among students. The use of lecture method discourages initiatives, curiosity and creativity in students and does not offer them opportunity to interact effectively with their peers and learning materials.

Students' academic motivation is the tendency to find academic activities meaningful and worthwhile and to derive the intended academic benefits from the teaching and learning process (Dowson & Mclnerney, 2001). High academic motivation has consistently been linked to increase level of students' academic performance (Kushman, Sieber & Harold, 2000). Thus, the development of students' motivation in Nigeria secondary schools is a valuable objective for Physics teachers because of its inherent importance in enhancing students' performance in the subject. Mastery Learning Approach can help teachers organize personal responsibility and ensure congruence among learning goals, instructional techniques and procedures for assessing or evaluating students' learning. It provides a mechanism through which teacher can offer students regular feedback on their learning progress and guidance in correcting learning difficulties. In this study, the researcher investigated the Impact of Mastery Learning Approach on Motivation and Performance in Wave Concepts among Senior Secondary School Physics Students in Zaria, Kaduna State, Nigeria.

1.3 Objectives of the Study

The study has the following objectives. To:

1. determine the impact of mastery learning approach on secondary school Physics students' performance,
2. determine the impact of mastery learning approach on secondary school Physics students' motivation,

3. find out if there is any difference in performance of male and female students when taught using mastery learning approach and
4. determine if there is any difference in motivation of male and female students when taught using mastery learning approach

1.4 Research Questions

The following research questions are formulated for answering:

1. What is the difference between the mean scores of students taught using mastery learning approach and those taught using lecture method?
2. What is the difference between level of motivation between students taught using mastery learning approach and those taught using lecture method?
3. What is the difference between the performance mean scores of male and female students taught using mastery learning approach?
4. What is the difference between level of motivation of male and female students taught using mastery learning approach?

1.5 Null Hypotheses

The following null hypotheses are formulated based on the research questions for testing at $P \leq 0.05$ level of significance:

H01: There is no significant difference between the mean scores of students taught using mastery learning approach and those taught using lecture method

H02: There is no significant difference between level of motivation of students taught using mastery learning approach and those taught using lecture method.

H03: There is no significant difference between the performance of male and female students taught using mastery learning approach.

H04: There is no significant difference between level of motivation of male and female students taught using mastery learning approach.

1.6 Significance of the Study

It is hoped that the findings of this study would contribute to the growing body of knowledge in the following ways:

Physics Teachers: The findings of this study may benefit teachers in their choice of effective and relevant approach in teaching physics.

Students: The findings may also benefit students to adjust in the level of mastery and performance in physics.

Curriculum Planner: The findings could motivate curriculum planner to incorporate the use of mastery learning approach in physics curriculum.

Researchers: Fellow researchers may use the outcome of this study to replicate it in other study areas, improve on it or adopt it for similar studies. The outcome of this study may also serve as a basis for further researches.

Government: It may also be of benefit to the federal and state government toward the development of individuals by providing useful information on ways of giving their citizens qualitative physics education.

Professional Bodies: Professional bodies like Science Teachers Association of Nigeria (STAN) and Mathematics Association of Nigeria (MAN) may use the findings of this study to organize workshops, seminars and conferences for teachers especially on how to incorporate it in teaching.

1.7 Scope of the Study

This study investigated the Impact of Mastery Learning Approach on motivation and performance in wave concepts among senior secondary school Physics students in Zaria, Kaduna State. It is delimited to all public coeducational senior secondary school two (SSII) in Zaria Education Zone, Kaduna State, Nigeria. The reason for restricting this study to public schools is that they are the majority and have similar administrative structure. The choice of SSII students is because they are fully settled and they are not facing their final year examinations like SSIII. The SSI students are new to the system and are not settled and as such not use. Selected concepts of the study will be from Senior Secondary School (SS II) Physics Syllabus. These are: production & propagation of waves, types of Waves, properties of waves, light and sound waves and calculations involving waves. The choice of these concepts can be justified based on the fact that the Physics curriculum emphasized its teaching at SSII. Moreover, the concepts are perceived to be abstract in nature having limited instructional facilities (Adeyemo, 2010). More so, the concepts appear annually in the S.S.C.E and perceived by students as difficult concepts that contribute to their low performance (WAEC Chief Examiner's Report, 2013).

1.8 Basic Assumptions

The study has the following assumptions:

1. Students can learn all important academic content to a level of excellence.
2. The students under study have prerequisite adequate knowledge of wave concepts taught.

3. The teachers teaching Physics in schools selected for the study are qualified and competent to teach wave concept
4. The schools have Physics laboratory with adequate equipments.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

This study investigates the Impact of Mastery Learning Approach on motivation and Performance in Wave Concepts among Senior Secondary School Physics Students in Zaria, Kaduna State, Nigeria. This chapter reviews literature based on the following sub-headings:

2.2 Teaching of Physics as a Discipline in Science Education

2.3 Methods of Teaching Science

2.3.1 Lecture Method of Teaching Science

2.3.2 Methods of Teaching Physics

2.3.3 Concept of Mastery Learning Approach

2.4 Motivation and Performance in Science

2.4.1 Motivation and Performance in Physics

2.5 Gender and Academic Performance in Science Education.

2.5.1 Gender and Academic Performance in Physics

2.6 Overview of Similar Studies.

2.7 Implication of the Reviewed Literature for the Present Study.

2.2 Teaching of Physics as a Discipline in Science Education

Physics is a science subject that deals with the study of matter and the interactions between the fundamental constituents of the observable universe. In the broadest sense, Physics (from the Greek Physikos) is concerned with all aspects of nature on both the microscopic and submicroscopic levels. It deals with not only the behaviour of objects under the action of given forces but also the nature and origin of gravitational, electromagnetic and nuclear force fields.

Olumuyiwa and Okunola (1992) defined Physics as a branch of physical sciences that concern mainly with matter in relation to energy. Physics as a science subject has been acknowledged as a pre-requisite for the study of several courses in the university, for examples, engineering, medical and other applied science courses need physics. In the words of Olarinoye (2000:20) "Physics is the most utilized basic science subject in most technology and technology related profession". According to Ike (2002), Physics deals with the study of laws that determine the structure of the universe with reference to the matter and energy in the universe. Adeyemo (2010) added that Physics is a unique subject which promotes the acquisition of specialized science skills and knowledge which explain the natural phenomena of life in the society. It is a subject that grew up with civilization as man's quantitative needs increased. It arose out of practical problems and man's need to solve these problems. It has contributed to the development of the sciences and to the development of civilization.

Josiah (2012) posited that the importance of physics for the development of a nation is, therefore, glaring. Physics is one of the basic sciences, its concept and techniques strengthen the understanding of all other branches of science. Physics is a cross-cutting

discipline that has applications in many sectors of economic development including health, agriculture, water and energy, and information technology. The understanding of Physics is quite necessary for developing new instrumentation and techniques in the health sector. For example, with the help of medical Physics, the right equipment for the diagnosis of diseases and the efficient communication of medical data are acquired. In developing fixed-line and optical-fiber in information technology, knowledge of Physics that underpin these technologies is essential. Its ultimate objective is the formulation of a few comprehensive principles that bring together and explain all such disparate phenomena. The technological growth of a nation, as noted by Josiah (2012), leads to its social and economic development. Thus, the discipline of physics is a gate way to such development.

The main aim of teaching Physics at the Secondary School level is to contribute to the performance of the general objectives of science teaching, and to emphasize the specific nature of Physics and its relations with other science disciplines. The other aims of teaching Physics as cited by Adeyemo (2010) include the following:

i. Giving the students a scientific knowledge through enlarging their scope of knowledge; interpreting their scientific observations; understanding laws, models and theories of natural phenomena; and relating physical laws to technological applications.
ii. Preparing students for scientific careers based on Physics to awaken their scientific vocations.
iii. Making students aware of the scientific methods with all the rigors, intellectual honesty and critical thinking it requires. This consists of practicing the

experimental methods in order to develop the skills of observation, data collection and analysis; the Mathematical formulation of the laws of Physics and the construction of models and the resolution of concrete problems.

iv. Making students understanding the scientific messages contained in diagrams, graphs, and media.

v. Training students to express themselves scientifically through the use of the appropriate terminology and abstract representation.

The strategy employed by Physics teachers in an attempt to impact knowledge to the learner is referred to as methodology (Mkpanang, 2000). Nwagbo (2006) sees teaching method as the strategy or plan that outlines the approach that physics teachers intend to take in order to achieve the desirable objectives. It involves the way teachers organize and use techniques of subject matter, teaching tools and teaching materials to meet teaching objectives.

The teaching method that a teacher adopts is one factor that may affect students' performance (Mills, 1991). Also, Atadoga and Lakpini (2013) posited that the persistent low academic performance in science education is attributed to teacher instructional strategies, learning style preferred, among others. Thus, instructional strategies used by teachers in teaching- learning process have significant influence on learners' academic performance. Therefore, the use of appropriate teaching method is critical to the successful teaching of Physics. Regrettably, most science teachers in a bid to cover their syllabus adopt the lecture based method in teaching (Ali & Akubue 1998). The lecture method is mainly teacher centered and subject content driven (Liddle, 2002). It discourages initiatives, curiosity and creativity in learners and does

not offer them opportunity to interact effectively with their peers and learning materials. This has resulted in students' loss of interest, reduced participation in class and poor learning performance. Focusing on this, Nzewi (1993) advocated the use of a more effective method of teaching science; the mastery learning approach (MLA), no doubt can be one of such technique. Therefore, this research seeks to determine the Impact of Mastery Learning Approach on Motivation and Performance in Wave Concepts among Senior Secondary School Physics Students in Zaria, Kaduna State, Nigeria.

2.3 Methods of Teaching Science

The issue of teaching methods and their effect on secondary school science students' performance has been a very important issue in the recent times. The importance of science and technology in the growth of and development of any nation cannot be overemphasized. It is evident that science and technology cannot thrive without using appropriate instructional methods. Future development of any nation in the fields of science depends on how well the science subjects are taught.

There are several methods of teaching and learning science subjects in the course of presenting scientific facts, information, principles and skills on concepts to the students. Some of the methods includes: mastering learning approach, demonstration, inquiry, discovery, discussion, project, laboratory, individualized, fieldtrip, excursion and lecture/ direct expository methods, to mention but a few. Some of these methods which have their characteristics advantages and disadvantages are specific for some situation and categories of students, while others can generally be applied to all categories of students (Atadoga & Onaolopo, 2008)

Olorukooba (2001) described the method as a teacher-centered method in which the teacher does the bulk of the talking as he presents large bodies of facts and principles to many students whose role are relegated to that of passive learners. This description is in agreement with an earlier view of Olorukooba (1981) when she stated that the method aims at collecting a large body of information to be disseminated to as large group of people as possible and in the shortest period of time with minimal cost. Atadoga & Onaolopo (2008) also described the method as a didactic approach, defining it as a teaching technique in which one person usually the teacher presents a spoken discourse on a particular subject. They further opined that the method is used for elaborating, simplifying, clarifying and discussing new materials to learners. The method was reported as not being expensive since only chalk and chalk board are required. It allows for easy coverage of syllabus as well as being a faster way to communicate scientific information and facts. Despite these points, the method does not auger well for meaningful learning of science. Since much emphasis is on the sense of hearing. It does not cater for the various ability groups that can be identified in a class. Also it can be boring and frustrating as learners are made to sit for further long-time, writing and listening. It also encourages rote learning without necessary aiding understanding.

Okwilagwe (2003) noted that the method mostly used for teaching and learning of science in Nigerian schools is lecture method, and is not so effective because the students are not given opportunity to interact with the environment and maximally develop their intellectual capabilities. Researches on teaching methods had shown that lecture method had negative effects on students (Okwilagwe, 2003). Such effects include lack of motivation, inability to cover the content of the curriculum, negative attitude towards the

subject and poor performance on the parts of the students and teachers. Lecture method is often the method of choice when introducing and exploiting new concepts. Lecture allows a great deal information to be passed to the learners and favors handling of large classes. It encourages students to cram facts which are easily forgotten (Okwilagwe, 2000). Adeyemi (2003) stated that lecture is inappropriate and ineffective for achieving the high objective of science. Therefore, this research work investigated the Impact of Mastery Learning Approach on Motivation and Performance in Wave Concepts among Senior Secondary School Physics Students in Zaria, Kaduna State, Nigeria.

2.3.1 Lecture Method of Teaching Science

There are various methods that can be used for the presentation of scientific facts, principles, information and concepts to students. One of the oldest and most commonly used method however remains the lecture or expository method (Olorukooba 2001 & Ada 2006). Olorukooba (2001) described the method as a teacher-centered method in which the teacher does the bulk of the talking as he presents large bodies of facts and principles to many students whose role are relegated to that of passive learners. This description is in agreement with an earlier view of Olorukooba (1981) when she stated that the method aims at collecting a large body of information to be disseminated to as large group of people as possible and in the shortest period of time with minimal cost.

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At least eighty percent (80%) of scientific information or principles are passed on to students through lecture method (Adesoji, 2008). He further opined that, many academicians have accepted lecture method as a proper way of imparting knowledge since our educational system puts so much premium on external examinations. Lecture method helps a science teacher covers a large amount of materials (syllabus) to a large class size in a very short period. This is however detriment to students learning, but the teacher may not have a choice being driven by the pressure to cover the syllabus and prepare the students for the external examination which is the only qualifying measure to the next level or employment.

Bichi (2002) posited that seventy five percent (75%) of the scientific information or principles that students received from their teachers comes through expository method. When science is taught using lecture method, students often rote learn and in the process miss an essential part of the science learning. For this study, lecture method will be used to teach the control group.

2.3.2 Methods of Teaching Physics

The term teaching methods refers to the general principles, pedagogy and management strategies used for classroom instruction (Jackson, 2012). According to Sharma (2012),

methods are the ways and means through which the curriculum is transacted through teachers to the students. It is a link in the process of teaching and learning environment. Joshi (2008) define methods to include a utilization of appropriately selected curriculum materials, content and learning experiences, motivational strategies, an application of learning theories and a demonstration of a knowledge of developmental psychology or other aspects of educational psychology in the teaching and learning process. Ogbonna (2000) opines that one of the most influential factors in teaching is the teachers' method of teaching. Ahmed and Abimbola (2011) and Umar (2011) have identified poor teaching methods adopted by teachers at senior secondary school level in Nigeria as one of the factors contributing to the poor performance of students in science subjects.

There are a variety of methods and techniques for teaching the sciences. These include; laboratory method, project method, inquiry method, discussion method and lecture method. The laboratory method of teaching is based on the principle of learning by doing. The students make use of their hands or eyes or very often both. The school laboratory according to Usman (2010) is an instructional facility used by teachers to help students learn about science and how scientists investigate the world around them. The students are led to obtain information by their own active efforts (Joshi, 2008). It is psychologically sound because it satisfies the urge for activity which is fundamental derives in human beings. The proper material and equipment and physical setting help to motivate the students to drink deep from the well of knowledge (Joshi, 2008). It is through the activity that the child is helped to feel the significance of what he is learning. In this method, the students are encouraging finding out, thinking about and experience things for themselves and by themselves. In this method, the students are not mere

listeners but are active participants in the lesson. However, the laboratory method has some demerits (Joshi, 2008). It is very slow method of learning. It is not easy to make the students discover Physical facts or concepts by experiments. The method is also expensive. The method also makes heavy demands on students since it is expected that each students should vary by performing experiment. Usman (2010) in his work proved that laboratory method improved students' academic performance in integrated science. He also identified two types of laboratory; indoor and outdoor laboratory. The indoor laboratory is a room/building where scientific work and research is carried out. While the outdoor laboratory is an open space mapped out for scientific activities.

Project method is an educational enterprise in which children solve a practical problem over a period of several days or weeks. It may involve building rocket, constructing an electric bell, hydraulic press, beam or lever balance and so on. This is a method in which students learn through independent activity under the guidance of a teacher (Olaitan & Agusiobo 1992). The project teaching may be suggested by the teacher, but they are planned and executed as far as possible by the students themselves individually or in group. The use of project in teaching Physics has to do with assigning work to students or asking them to select certain work and complete it on their own time outside the scheduled class laboratory time. It helps to stimulate students' interest and motivation to the study of technical facts and related knowledge in all spheres of learning. It offers a normal organizing centre for new acquisition of skills and knowledge. It is highly useful in developing modes of thought, and understanding of the procedures and characteristics of an occupation. It is also adaptable to the occupations for which vocational education trains the individual in skills of practical value especially those requiring personal

initiative and creativity. Projects are important real world modules by which modern Physics and everyday life problems can be integrated into high (or secondary) school curriculum (Holubova, 2008).

According to Olajide and James (2000), inquiry method is an art of questioning, exploring and experimenting which is the process of science. Scientific inquiry progresses through a continuous process of questioning, data collection, analysis and interpretation (Logan, 2008). In scientific inquiry, students engage in a thoughtful and coordinated attempt to search out, describe and explain and predict a natural phenomenon (Lohrman, 2013). As highlighted out by Hassard (2005), inquiry method of teaching is of two types: guided inquiry and open inquiry. In guided inquiry, the students determine the methods they will use to produce their own conclusions to a problem posed by the teacher, and as such, the teacher plays the role of a guide to the students. In the open inquiry, the students select the topic to be studied and the methodology used to yield their own conclusions from the investigation. Research has shown that students who have historically been low achiever in science can succeed in inquiry based-learning (Blanchard, 2010). However, Joshi (2008) is of the opinion that inquiry method can be time consuming and slow and may not be suitable under the structured school curriculum.

In the discussion method, as it is true with any group learning effort, the instructor typically relies on the students to provide ideas, experiences opinions and information. An instructor may use this during classroom periods, after the students have gained some knowledge and experience. Fundamentally, the discussion method is almost the opposite of lecture method. The instructor's goal is to draw out what the students know, rather than to spend the class period telling them (Joshi, 2008). It is one of the most easily

comprehended method of teaching as students are daily involved in one form of discussion or another within or outside the school (Atere, 2006). The discussion method places emphasis on learning than teaching and encourages participation by everybody. Thus, there is a development of democratic way of thinking and arriving at decision. Students, during the course of discussion get training in reflective thinking which leads to deeper understanding of the historical problem under discussion. During discussion, everybody is required to express his ideas and opinions in a clear and concise manner. This provides ample opportunities to the students for training in self-expression. Discussion can take place between and among small or large groups of learners during which they can contribute, share, examine and suggest prove, argue, accept or reject ideas or opinions. However, the teacher serves as the facilitator, guide, assistant, moderator or contributor to discussion.

Lecture method is also referred to as conventional methods or expository method of teaching. It is also referred to as the traditional method of teaching and is the oldest method of teaching. According to Appaw (2011), it is mostly described as teacher-centered, teacher dominated, teacher activity method, or top down transmission teaching. It involves verbal presentation of ideas, concepts and generalization of facts (Umar, 2006). The role of the students is less active and more passive in the teaching and learning interaction. It is effective in teaching basic fundamental skills across all content areas (Jackason, 2012). Basically, the teacher controls the instructional process, the content is delivered to the entire class and he tends to emphasize factual knowledge. It allows a great deal information to be pass to the learners but it does not stimulate students' innovation, inquiry and scientific attitude. For effective teaching to take place,

skillful Physics teacher need to use different teaching methods, techniques and approaches at his disposal. A carefully designed teaching method can make teaching and learning effective (Chang & Mao, 2008). It has been noticed that the methods that results in positive effect on students' learning are those based on collaboration between teachers and students. Focusing on this, Nzewi (1993) advocated the use of a more effective method of teaching science; the mastery learning approach (MLA), no doubt can be one of such technique. Therefore, this research seeks to determine the Impact of Mastery Learning Approach on Motivation and Performance in Wave Concepts among Senior Secondary School Physics Students in Zaria, Kaduna State, Nigeria.

2.3.3 Concept of Mastery Learning Approach (MLA)

Mastery learning approach (MLA) is an instructional method where students are allowed unlimited opportunities to demonstrate mastery of unit taught (Kibler, Cegala, Watson, Barker & Miler 1981). According to Davis and Sorrel (1995:15) "the mastery learning method divides subject matter into units that have predetermined objectives or unit expectations. Students alone or in groups, work through each unit in an organize fashion. Students must demonstrate mastery on unit exams typically 80%, before moving on to new material. Students who do not achieve mastery receive remediation through tutoring, peer monitoring, small group discussions or additional homework. Additional time for learning is prescribed for those requiring remediation. Students continue the cycle of studying and testing until mastering is met. Block (1971) states that students with minimal prior knowledge of material have higher achievement through mastery learning than with traditional methods of instruction.

Guskey (2007) noted that mastery learning curricula generally consist of discrete topics which all students begin together. After beginning a unit, students will be given a meaningful and formative assessment so that the teacher can conclude whether or not an objective has been mastered. At this step, instruction goes in one of two directions. If a student has mastered an objective, he or she will begin on a path of enrichment activities that correspond to and build upon the original objective. Students who do not complete a topic are given additional instructional until they succeed. If a student does not demonstrate that he or she has mastered the objective, then a series of correctives will be employed. These correctives can include varying activities, individualized instruction, and additional time to complete assignments. These students will receive constructive feedback on their work and will be encouraged to revise and revisit their assignment until the objective is mastered.

In a mastery learning classroom, teachers follow a scope and sequence of concepts and skills in instructional units. Following initial instructional, teachers administer a brief formative assessment based on the unit learning goals. The assessment gives students information , or feedback, which helps identify what they have learned well that point (diagnostic) and what they need to learn better (prescriptive). Students who have learned the concept continue their learning experience with enrichment activities, such as special projects or reports, academic games, or problem solving tasks. Students who need more experience with the concept receive feedback paired with corrective activities, which offer guidance and direction on how to remedy their learning challenge. To be effective, these corrective activities must be qualitatively different from the initial instruction by offering effective instructional approaches and additional time to learn.

The most important feature of (MLA) is that it accommodates the natural diversity with any group of students, according to their levels of understanding. The goal of MLA is success for the student, in performance and motivation. It is therefore on the basis of this that this research work will employ the use of Mastery Learning Approach to teach the experimental group wave concepts in order to find its impact on performance and motivation.

2.3.2.1 Mastery Learning Models

The following are the mastery learning models:

i. Washburne's model (1922)
ii. Morrison's model (1926)
iii. Mastery learning as a programmed instruction (1950)
iv. Carroll's model of school learning (1963)
v. Bloom mastery learning model (1968)

2.3.2.2 Washburne's Model (1922)

Winnetka plan of Washburne and his associates is a major attempt of the early 1920's to produce mastery in student's learning. The special features are:

i. Mastery is defined in terms of particular educational objectives each student is expected to achieve. Here much importance is given to cognitive objectives.
ii. Instruction is organized into well-defined learning units. Each unit consists of a collection of learning materials systematically arranged to teach the desired unit objectives.
iii. Complete mastery of each unit is required of students before proceeding to the next.

iv. Administration of a diagnostic progress test at the completion of each unit to provide feedback on the adequacy of the students' learning.

v. Based on the diagnosis, provide supplementary materials for further learning. Here primarily self-instructional materials are used in addition to small group discussion or individual tutoring by the teacher.

Winnetka plan allows each student to move in his own pace by taking his own time to master a unit. Thus it was a self-paced learning technique

2.3.2.3 Morrison's Model (1926)

Morrison (1926) was a professor at the University of Chicago's laboratory school. According to his teaching procedures, the outcome of all teaching is not memorization of facts, but mastery is reached only when planned understandings have been grasped thoroughly. The major features of this teaching procedure are:

i. Defining Cognitive, affective and psychomotor objectives.

ii. Division of each subject into units. A unit is typically conceived as a piece of work, based upon a certain quantity of related facts in a text- book or other source. A unit is a generalization and its related facts are developed according to a sequence of steps.

iii. Mastery is to be attained on the basis of the specified objectives. Each unit should present a specific understanding with such thoroughness that most students achieve mastery. A unit is covered only when all or almost all students thoroughly understood the generalization, its factual origins, it's probable reliability, and the kinds of situations in which it could be used in the future.

iv. Administration of an un-graded progress test at the completion of each unit to provide feedback.

v. After diagnosis a variety of correctives such as re-teaching, tutoring, re-structuring the original learning activities and re-directing student study habits are to be used.

In Morrison's method each student is allowed the teaching time based on attainment of unit mastery by all or almost all students. Our teaching would undoubtedly be improved if Morrison's thinking were more widely understood.

2.3.2.4 Mastery Learning as a Corollary of Programmed Instruction (1950)

The Winnetka plan and Morrison's method were flourished during 1930's; however, without the technology to sustain a successful strategy, interest among developers and implementers steadily diminished. Mastery learning was revived in the form of programmed instruction in the late 1950's in an attempt to provide students with instructional materials that would allow them to move at their own pace and receive constant feedback for their level of mastery. A basic idea underlying Programmed Instruction was that the learning of any behaviour, no matter how complex, rested upon the learning of a sequence of less-complex component behaviours (Skinner, 1954). The component behaviours are sequentially arranged in the form of a chain and by ensuring student mastery of each link in the chain, it would be possible for any pupil to master even the most complex skills. The major steps of Programmed Instruction are:

i. Complex behaviour is split up into sequential less-complex behaviours.

ii. Presentation of each component behaviour in small steps called frames

iii. After completion of each frame pupil respond to a diagnostic question, which determines the mastery or non-mastery of the component behaviour.

iv. Immediate feedback. If the response is correct, learning is reinforced and he can proceed to the next frame. Otherwise his error 1s corrected immediately.

The Programmed Instruction is effective only for some students who require small learning steps, practice and immediate reinforcement. It acts as an important tool to attain mastery but it did not suit as a useful mastery learning model.

2.3.2.5 Carroll's Model of School Learning (1963)

Mastery learning is rooted in Carroll's Model of school learning. In his Model, Carroll stated that all the variables that directly influence the learning of children in school could be defined in terms of time. "The learner will succeed in learning a given task to the extent that he spends the amount of time he needs to learn the task" (Carroll, 1963). Carroll indicates that if a student is allowed the time he needs to achieve a particular level and if he spends the amount of time needed, he should achieve at that level The model considered degree of learning as a function of the amount of time the learner actually spends on the learning task to the total amount needed.

$$\text{Degree of learning} = f\left(\frac{\text{Time actually spent}}{\text{Time needed}}\right)$$

Carroll used five elements such as aptitude, ability to understand instruction, quality of instruction, opportunity to learn and perseverance to explain the degree of learning a particular task.

Major Propositions of the Model

i. A student's aptitude has traditionally been seen as an index of the level to which a child could learn in a given amount of time. From this viewpoint children tend to be considered as either good or poor learners. Carroll suggested viewing aptitude as an index of amount of time required by a child to learn the subject to a given level. Thus, instead of being aptitude as a measure of ability to learn a particular subject, or of specific learning potential Carroll suggested that it could be viewed as a measure of learning rate. From this perspective children are seen as being fast or slow learners rather than as good or poor learners.

ii. The degree of learning for any student in a school setting is a function of the time he actually spends in learning relative to the time he needs to spend. Thus, to the extent that each student is allowed sufficient time to learn a given subject to some pre specified level, and he spends the time needed to learn, the student will definitely learn the subject to the specified level.

iii. In a school-learning situation, the time a student actually spends learning a subject as well as the time he needs to spend will be determined by certain instructional and personal characteristics. The two major instructional characteristics are the student's opportunity to learn (i.e the amount of classroom time allocated to learning the subject) and the quality of instruction (i.e., the degree to which the presentation, explanation, and ordering of the elements of the subject are optimal for the student). In addition to aptitude, the relevant personal characteristics are the student's ability to understand instruction and his perseverance

2.3.2.6 Bloom Mastery Learning Model (1968)

In the mid 1960's Bloom began a series of inventions on how the most powerful aspects of tutoring and individualized instruction might be adapted to improve student learning in group-based classes. Bloom's contribution to the development of mastery learning was to transform the conceptual model of school learning developed by Carroll into a working model for mastery learning. In Carroll's model, aptitude was predictive of the rate at which, rather than the level to which, a student could learn. Therefore, it should be possible to fix the degree of learning expected of students at some mastery level and to systematically manipulate the relevant instructional variables such that all or almost all students attained mastery.

Bloom argued that if students were normally distributed with respect to their aptitude for a subject and were provided uniform instruction in terms of both quality and time, then their achievement at the subject's completion would be normally distributed. This situation can be represented as in Figure 2.1

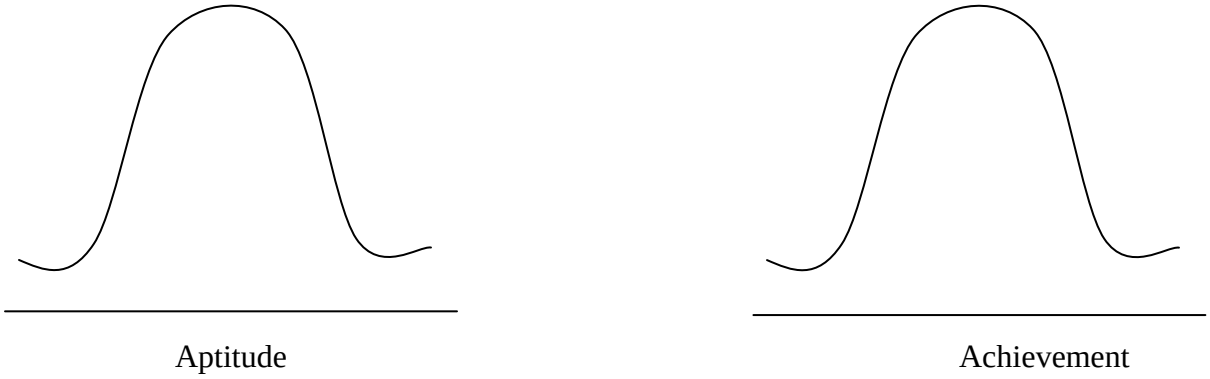


Figure 2.1: Bloom's Model Uniform Instruction per Learner

However, if students were normally distributed with respect to aptitude but the kind and quality of instruction and learning time were allowed to vary to suit the characteristics

and needs of each learner the majority of students could be expected to attain mastery. This situation can be represented as in Figure 2.2

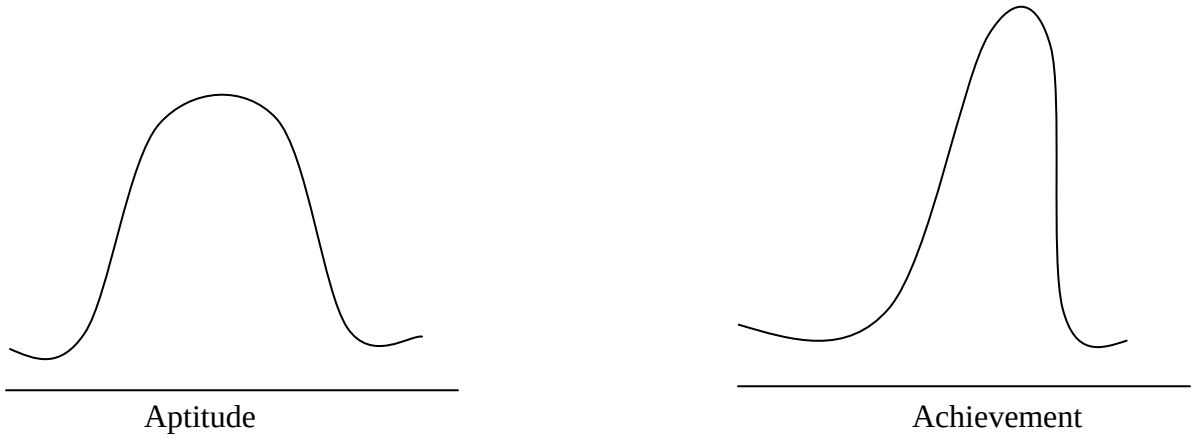


Figure 2.2 Bloom's Model Optimal Instructions per Learner

To determine how this result might be practically achieved, Bloom searched various sources of information. He studied ideal teaching learning situations where an excellent tutor paired with an individual student and tried to determine the critical elements in one-to-one tutoring that can be transferred to group based instructional settings. He also tried to collect information regarding the strategies employed by academically successful students. Based on the series of studies conducted, Bloom (1968), outlined a specific instructional strategy labeled as 'Learning for Mastery' and later shortened it to simply 'Mastery Learning' (1971). The various stages of this approach are:

i. The concepts and materials the students are to learn are first organized into instructional units. A unit is composed of the concepts presented in about a week or two of instructional time.

ii. Initial instruction on the unit by adopting suitable methods.

iii. A quiz or assessment is given to students for giving students information or feedback on their learning. Bloom called it 'formative assessment'.

iv. Enrichment activities is given to students that mastered the unit taught

v. Suggestions to students as to what they might do to correct the learning difficulties identified on the assessment. Correctives are individualized and students need to work for the mastery of non-mastered concepts. They may point out additional sources of information on a particular topic, such as the page numbers in the course textbook or workbook where the topic is discussed. They may identify alternative learning resources such as different textbooks, alternative materials, learner centered activities, or computerized instructional lessons, or they may simply suggest sources of additional practice, such as study guides, independent practice or guided practice activities.

vi. Administration of a parallel formative assessment when the students complete their corrective activities usually after a class period or two. This is necessary to check on the effectiveness of the correctives in helping students to overcome their individual learning difficulties. It also offers a second chance for the students to succeed and hence serves as a motivational device. The model's flowchart is presented in Figure 2.3

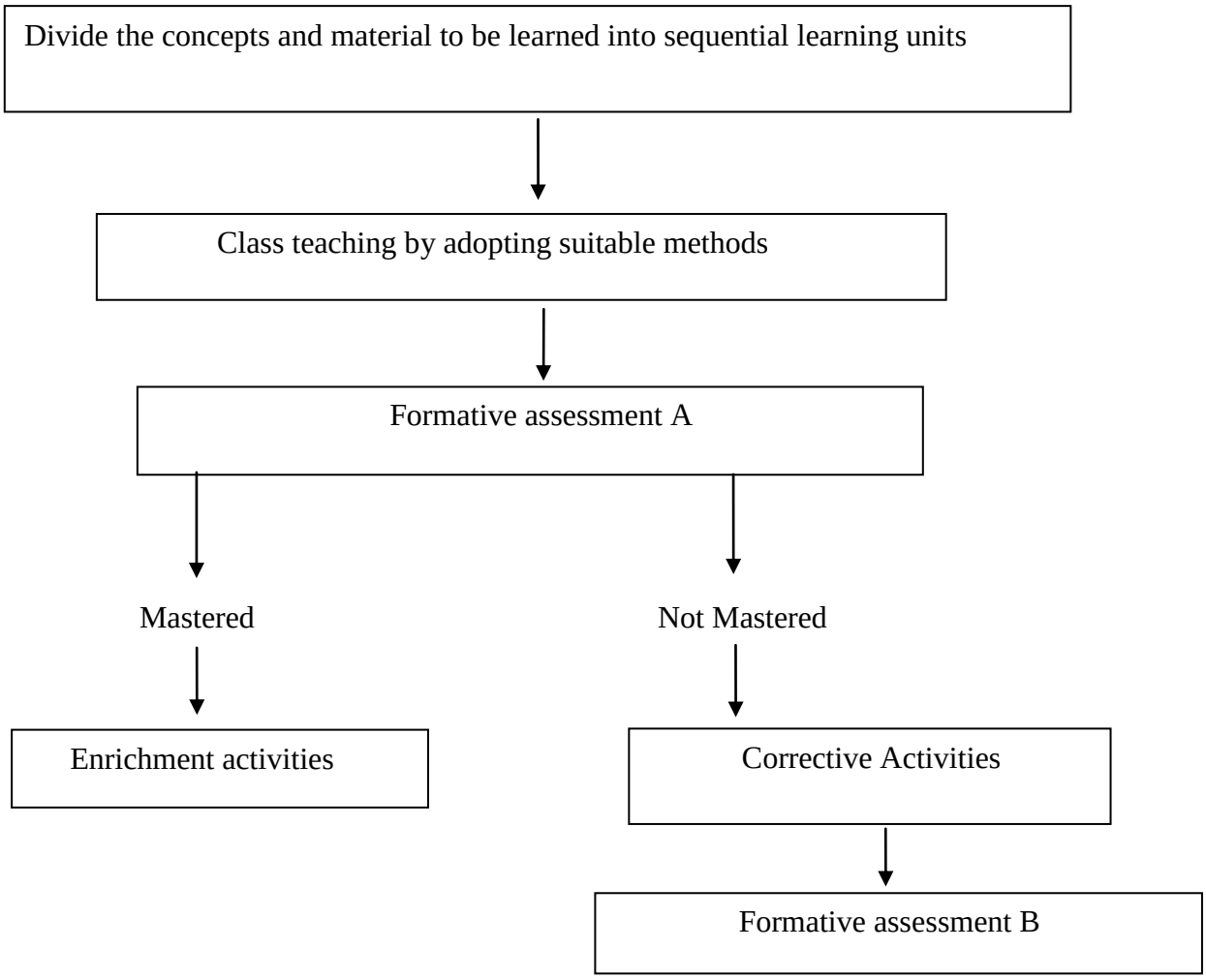


Figure 2.3: Bloom's Mastery Learning Flowchart

Source: Adopted from Bloom (1968)

Therefore, the researcher chose Bloom's model for this research under study. This is because, Bloom (1968) believed that through this process of formative assessment combined with the systematic corrections of individual learning difficulties, all students could be provided with a more appropriate quality of instruction than is possible under more traditional approaches to teaching. Besides, if related introduction features of the students along with the teaching activities are positive, the learning output will reach a high level and the differentiation between the students in terms of performance will be at

a minimum level (Sever, 1997). Therefore, this study adopted Bloom's mastery learning model to determine its impact on motivation and performance in wave concepts among senior secondary school Physics students in Zaria Education, Kaduna State, Nigeria.

2.4 Motivation and Performance in Science

Psychologically, motivation is the biological, emotional, cognitive or social forces that activate and direct behaviour. Motivation is defined in social cognitive theory as an internal state that arouses, direct, and sustains goal-oriented behaviour (Chaunhan, 1973). Consistent with social cognitive theory, Heinch, Molenda, Russell, and Smaldino (2002) define motivation to learn science as an internal state that arouses, direct, and sustains science-learning behavior. Students who are motivated to learn science and engage in science-learning behaviour pursue goals such as good science grades and science-related careers. Motivation is the act of giving somebody reason to do something in a particular way. Aschbacher, Lee, and Roth (2010) also report that "various emotional factors have been found to influence what we pay attention to, how long we pay attention, how much effort we invest in learning and how feeling may interfere with learning". Motivation is a product of internal drives and external goals that interact with learning to produce behavior or act in a certain manner. Many students do not perform well in school subjects due to lack of interest and end-up dropping out of school. Motivation as reported by Odera (2010) as an essential aspect of teaching and learning, and one of the forces that guide students' actions. These forces arise as a result of interaction from consciously or unconsciously factors such as desires, needs, incentives, or rewards, values and expectations of an individual which influence his/her choice of alternatives behavior.

Pajares, Britner and Valiante in Achor and Orji, (2009) stated that motivation in science education significantly and positively predicted students' performance. Achor and Orji (2009) & Ritter (2011) have conducted separate researches on the Level of Students' Motivation in Classroom interactions in the teaching of Integrated Science and on the Effects of Interactive Engagement on Motivation, Participation, and conceptual Understanding in Physics respectively. The results of their researches indicated that the teacher-students and student-student interactions impact positively on students' academic performance, and the students show increased motivation when they are allowed to share their thoughts within groups; within the class or with the teacher.

2.4.1 Motivation and Performance in Physics

Motivation is a strong desire or passion in a person that encourages him to try and do something in order to succeed. It is a construct that is built out of individual learning activities and experiences, and it varies from one situation or context to another (Bandura, 1997). Motivation effects student learning (Ormrod, 2000) and plays an important role in directing behavior towards a certain goal, increasing the effort and energy towards a goal, increasing the initiative and perseverance of an activity, and improves individual performance. Motivation is the key factor in keeping students in their learning process, and has been found to be the most significant factor that influences academic success (Pintrich et al., 1994). A motivated student will take care of his education, has a positive thinking and is always eager to learn (Ross, 1999). Teaching would be meaningless if the student is not motivated, even when the capacity and capability of teachers are high (Wallberg, 1988). Self-motivation is essential to generate the potential for excellence and is inter-related with the spirit and desire to succeed, as

well as having a strong impact on one's success and performance (Petri, 1986 & Singh et al., 2002). Students who have high or strong motivation have been found to possess a more positive attitude towards Physics (Ali, Ismail & Sedef, 2010), are willing to learn the subject more effectively (Pintrich & Maehr, 2004), and are able to contribute better in classes and in the school's overall development (Eccles et al., 1998). Highly motivated students are also generally linked to the increase in the levels of student success rates and reduced dropout rates (Dev, 1997; Blank, 1997). Therefore, understanding motivation is necessary in designing an instructional process that can attract students towards a taught subject (Fisher & Horstendahl, 1997).

It is well known that students' motivation is influenced by both internal and external factors that can start, sustain, intensify or discourage behaviors (Reeve, 1996). Internal factors include the individual characteristics or dispositions that a student brings towards his learning activity such as interest, responsibility for learning, effort, values and perceived ability (Ainley, 2004). On the other hand, external factors include external rewards that come from the outside of the individual, such as money, praises and grades. Study results have indicated that individuals who are intrinsically motivated, compared to those who are extrinsically motivated, master information and concepts longer (Dev, 1997), have more interest, excitement, fun, and confidence, which leads to enhanced performance, creativity, persistence, vigor, general well-being, and self-esteem, as well as more likely to be lifelong learners (Kohn, 1993; Ryan & Deci, 2000). Therefore, finding the ways to enhance intrinsic motivation for students is of utmost importance. Motivation plays a major role in students' academic work and in their performance. It reflects in students' choices of learning tasks, in the time and effort they devote to them, in their

persistence on learning tasks, in their coping with the obstacles they encounter in the learning process. Previous research (Wiegfield, Harold, Freedman, Ecles, Yoon, Arbreton & Blumenfeld, 1997; Zohar, 1998; Bandalos, Geske & Finney 2005; Chemers, Hu & Garcia, 2005; Senko & Harackiewicz, 2005) showed that students' performance goals, their interest in courses and their success expectancies were positively related to their final course grade.

Research findings of Walberg in Singh, Granville, and Dike, (2002) showed that motivational variables and instructional time have the largest effect on eight- grade performance. Continuing, Singh, Granville, and Dike (2002) noted that the body of accumulated research in the last two decades indicates that motivation is one of the salient predictors of performance in mathematics and science. Such research works which link performance in science with motivation includes the findings of Brown and Walberg (1998), Nolen (2003), Geary and Hamson (2007). Psychological studies have provided insights on the effect of motivation on student's performance in Physics, mathematics and science. Geary and Hamson (2007) for instance found that explaining the importance of mathematics to students as a motivational variable, increased the participation in science classes in high school.

Studies which specifically investigated students' motivation and ability have yielded interesting findings in relation to their motivation. Talib, Wong, Azhar, and Abdullah (2009) conducted an in-depth study on motivation of students with outstanding performance in academics and revealed that good science learning outcomes do not rely on the way teaching is carried out but on many factors which include students' ability,

interest and motivation to learn. Feldhusen and Hoover (1986) identified self-concept and motivation as the most important factors for high ability students' academic performance. Other studies report that high motivated and ability students have higher scores than low ability and motivated students on academic goals, valuing science, and perceived ability (Debacker & Nelson, 2000) and they have more positive attitudes toward science in terms of interest and career in science than low ability and motivated students (Adams, 1996). Therefore, this study investigated the Impact of Mastery Learning Approach on Motivation and Performance in Wave Concepts among Senior Secondary School Physics Students in Zaria, Kaduna State Nigeria.

2.5 Gender and Academic Performance in Science Education.

Academic performance refers to the extent to which a student, teacher or institution has achieved their short or long-term educational goals Adamu (2001) posited that the computed or grades recorded for a group of learners is what constitute their academic performance for a given period of time. Linn (1992) opined that the performance of an individual for a given learning period influences his future choice career. He asserted that the ability of a student to make higher grades make such a student to choose courses in future that shows the correlation with his performance at lower level courses.

A student wishing to study medicine in future may be encouraged by performances in science subjects like: Biology, Chemistry, and Physics at lower level. If his record of performance at lower level is high with prerequisite subjects of the course he intends to pursue, then he is more likely to make success orr even excel iin his intended field (Wong, 2006). According to the International Assessment Event of Education Progress (IAEP, 1992), students making meaningful progresses in their choices of career are those

mostly with relevant background and a good record of academic performances at lower level.

Research work carried out on gender related effects on academic performance have shown a markedly low performance of females students than their male counterparts in science educational programme and science related courses (Sharma, 2013). This low performance of females over their male counterpart lead to greater dominance of males over females compared to their male counterparts in the field of science and technology has lead many scholars to say that science is gendered as it is practice (Akanbi, 2002).

In a study conducted by Abiola (2007) requesting male and female students to indicate their preference in the choice of subjects, using rank correlation coefficient, he observed that male students preferred to learn mathematics manipulative skills for subjects such as Physics and engineering courses while their female counterparts preferred subjects such as Biology and other subjects that required reading skills like literature. This argument however, can be valid in coeducational schools and may not necessarily be valid in places where schools are single sexed schools (Oladejo, 2011). Bichi (2002) observed that female students generally do not like practical work and thus cannot effectively learn under teaching method involving practical activities. Science teachers play a vital role in addressing the problem of gender in science education. According to Levi (2000), there are three roles a science teacher must play. Namely:

i. Ensure provision of equal opportunities and respect for differences in the classroom.
ii. Ensure that boys and girls have the same experience and that is, treat boys and girls equally.

iii. Compensate for gender difference in the society.

In order for concepts in Physics to be properly learnt and understood, the methods used in teaching the concepts play a vital role. Poor performance in Physics could be attributed to many factors among which teacher's strategy was considered as an important factor (Adeyemo & Babajide 2014). This implies that the mastery of Physics concepts might not be fully achieved without the use of instructional materials. Franzer, Okebukola and Jegede (1992) stressed that a professionally qualified science teacher no matter how well trained, would unable to put his ideas into practice if the school setting lacks the equipments and materials necessary for him or her to translate his competence into reality. Nwaigbe (2001) opined that lack of instructional materials is a factor responsible for women backwardness in science literacy. This study seek to investigates the impact of mastery learning approach on secondary school Physics students motivation and performance will therefore fill this gap of gender difference in teaching and learning Physics.

2.5.1 Gender and Academic Performance in Physics

It is of obvious fact that the study of Physics cannot be effectively carried out without an empirical analysis of some of the factors that do impede the study of the subject. According to Akinyele (2011), the academic performance of students in secondary schools has been a subject of concern to many people including parents, administrators, educators, psychologists and counsellors. The poor performance of students in science especially Physics has continued to be a major concern to all and particularly those in the main stream of science education (Ariyo 2006). Eryilmaz (2004) observed that gender contributes to poor performance of students in Physics. Gender according to Yang (2010)

refers to the social attributes and opportunities associated with being male and female and the relationships between women and men; girls and boys, as well as the relations between women and those between men. These attributes, opportunities and relationships are socially constructed and are learned through socialization processes. According to Mbajiorgu (2003), female enrolment in Physics and science subjects in general is very poor. This is in line with the study by Gonzuk and Chargok (2001) which revealed that the number of females who study Physics in secondary and tertiary institutions is small compared to the number of boys. This difference in the number of females and males in the study of Physics has created gender disparity in the academic performance of students in Physics and science subjects as a whole. Gender difference was first investigated by sociologist of education. The focus was largely on female under performance at every level of the educational system. Therefore, there is need to promote the teaching and learning of Physics in schools especially among female student. Ajejalami and Busari (1990) identified the following factors as contributing to under representation of females in science and technology education in Africa;

- Lack of functional guidance and counseling services
- Relationship of sex to occupational prestige
- Influence of schooling
- Family background
- Interest among other factors
- Lack of adequate orientation programme
- Societal discrimination against females in education
- Occupational choice and adaptation of science and technology.

Fakorede (1999), in his own contribution posited that poor enrolment of girls in science subjects is due to:

- Inadequate opportunity for girls to study science,
- Inadequate performance of girls in science,
- Inadequate interest of girls in science,
- Unfavourable attitude of girls to science learning and
- Inadequate knowledge of girls on the true nature of science.

The critical belief of biological theorists is that gender differences are natural and therefore unalterable (Olubunmi, 2001). It would be right and proper to treat boys and girls in schools differently because their natural inclinations are different roles. Thus, theories were advanced that females excelled in language based subject because of their greater and reasoning abilities yet under performed in sciences because of their lower level of innate ability of shape and form factors. There are many research works conducted on gender and academic performance in Physics education. Some shows significant difference between male and female while others shows no difference. The findings of Achifusi and Mgbemena (2012) on the effect of mastery learning approach on academic performance of senior secondary school II Physics students revealed that female students performance better than their male counterpart. Similarly, the findings of Ordein and Awodun (2013) on the impact of teachers' motivational indices on science students' academic performance reveals gender difference in favour of boys in Physics. Njoku (2007) also reported that boys perform better than girls in science, technical and mathematical subjects. Furthermore, Appaw (2011) in his work using concept mapping

as a teaching method pointed out that the male students scored significantly higher than females

On the contrary, Shittu (2012) in his work on the effect of guided inquiry strategy on academic performance and attitude of low achiever in Physics concluded that the level of performance of male low achiever exposed to guided inquiry is the same with their female counterpart. Bello (2016) in his study on the impact of multimedia enriched-lecture method on retention and performance in Physics revealed no significant difference in the academic performance between male and female students exposed to multimedia enriched- lecture method. More so, Wambugu and Changeiywo (2008), Lamidi, Oyeleken and Olundare (2015) and Oluwatoosin and Bello (2015) revealed no significant difference in academic performance between male and female students.

One of the aims of this study is an attempt to shed more light on the above controversy using Mastery Learning Approach. The data obtained from the Physics Academic Performance Test (PAPT) was used to examine if there is any difference in gender academic performance.

2.9 Overview of Similar Studies.

Various studies had been conducted to determine the effectiveness of mastery learning approach on learners' learning outcomes. Some studies were conducted in Nigeria such as Adedeji (2007), Achufusi and Mgbemena (2012),Agboghoma (2014), Lamidi, Oyelekan and Olorundare (2015), Mitee and Obaitan (2015), and Haruna (2016) and elsewhere in the world like Keraro, Wachanga and Orora (2007),Wambugu and Changeiywo (2008), Baliiel, Duran and Bilgili (2011), Malik and Jamil (2012), Badola (2013), Wanjau (2014), Kumar and Sagar (2015) and Yusuf and Mohammed (2017) that

are either directly or indirectly related to this study. In this section, the researcher looked at these studies one after the other.

In a related study conducted by Achufusi and Mgbemena (2012), sought to find the effects of using Mastery Learning Approach on academic performance of senior secondary school II Physics students in Ogidi Education Zone of Anambra State; using pretest, posttest quasi-experimental study. Out of 513 of the total population of SSII Physics students in the zone, the researchers used purposive sampling technique to sample 40 students divided into two groups (20 males and 20 females) as experimental and control groups respectively. Physics Performance Test (PPT) was used to collect data and analyzed using mean, standard deviation and Z-test statistics. The result obtained revealed that the experimental group performed significantly (at $P<0.05$) better than the control group. The result further revealed that the female students performed slightly better than their male counterparts but the difference was not significant at $P=0.05$. This study is related to the ongoing research study in terms of instructional approach on students' performance and research design. It differs not only in sampling technique which is not up to 10% of the total population but also in method of data collection and analyses as motivation a variable of interest is introduced in the study under investigation.

Agboghoroma (2014) also investigated the effects of Mastery Learning Approach on secondary school students' integrated science performance. The researcher employed quasi-experimental; non randomized pretest, posttest control group design. Out of 18, 176 of the total population of the students drawn from 167 public Basic junior secondary schools in Delta State Senatorial District, 120 (JSSIII) students were sampled using

purposive sampling technique. A total of 30 students were drawn from each of the four (4) L.G.A. The instrument used for data collection was Integrated Science Performance Test (ISPT) which was pilot tested with a reliability coefficient of 0.74. The data was analyzed using ANCOVA statistics. The result of the study showed that MLA teaching method resulted in higher performance. It was also found that gender had no significant effect on the performance of students taught using MLA. The reviewed study is similar to the ongoing research work in terms of instructional approach on students' performance and uses same research design. It differs with the present study not only in subject area where the research was conducted but also in sampling technique and the instruments for data collection and analyses

In another research conducted by Lamidi, Oyelekan, and Olorundare (2015) on the effects of Mastery Learning Instructional Strategy on senior secondary school II students' performance in mole concept in Chemistry, Illorin metropolis . The study used a non-randomized, non equivalent pretest and posttest quasi-experimental research design. The researchers used two (2) government-owned secondary schools in Ilorin metropolis as their target population. A total of 110 students were sampled using purposive random sampling technique divided into two groups; 60 students (40 males and 20 females) as experimental and 50 students (30 males and 20 females) as control group. The instrument used was Performance Test on Mole Concept (PTMC). The data obtained was analyzed using t-test statistics and analysis of covariance (ANCOVA). It was found that students taught using mastery learning instructional strategy performed better (mean score 15.50) than their counterpart in the control group (mean score 7.04). It was also found that gender has no significant effect on the performance of the students using mastery

learning instructional strategy. This study is related to the present study under investigation in terms of instructional approach on students' performance and research design. It differs in subject area as well as sampling technique, motivation, geographical location and method of data collection and anlyses

Similarly, Oluwatosin and Bello (2015) examined the effects of Mastery Learning and Mind Mapping Approaches in improving secondary school students' learning outcomes in Physics. The study adopted non-equivalent pretest and posttest control group experimental design. The population of the study comprised of all senior secondary school Physics students in Ekiti State. Simple random sampling technique was used to select 74 students from three coeducational schools and assigned to experimental groups A, and B, and the control group C. the concepts taught were Gravitational and Electric fields The instrument used to collect data was Physics Achievement Test (PAT) with reliability coefficient of 0.78. The data collected was analyzed using t-test and ANOVA. The result showed that there was significant effect of treatment on the academic performance of students taught with MLA and MMA than their counterparts in the control group. This study is related to the present study in terms of instructional approach on students' performance and research design. It differs in terms of motivation, concepts taught, geographical location, sampling technique, and instrumentation for data collection and analyses.

Moreover, Mitee and Obaitan (2015) investigated the effect of Mastery Learning on senior secondary school students' cognitive learning outcomes in quantitative chemistry. Quasi-experimental control group design was used for the study. Out of 401 of the total population, 81 students were sampled using simple random sampling and assigned into

two groups; experimental and control groups. Chemistry Performance Test (CPT) drawn from stoichiometry and mole concepts was used for the study. The data was collected and analyzed using descriptive statistics and independent sample t-test. The result showed that mastery learning group had higher performance (mean score 78.2) than their control group (mean score 58.4). The findings also revealed that there is no significant difference between the performance of male and female students taught using MLA. This study is related to the ongoing research in terms instructional approach on students performance, research design, and sampling technique. It differs in subject area, concepts taught, sampling technique, motivation as well as instrumentation for data collection and analyses.

Haruna (2016) investigated the effect of peer instruction (PI) and just- in-time teaching (JiTT) on motivation, retention and performance among Physics students with varied ability in Kano State. Quasi- experimental of pretest, posttest, and post-posttest experimental and control group design was employed. Out of 6582 SSII students of the total population, 189 students were purposively selected and sampled; 92(50 male and 42 female) and 97 (52 male and 45 female) for experimental and control groups respectively. Two instruments were used for data collection; Physics performance test (PPT) drawn from Mechanics concept with reliability coefficient of 0.507 and the students' motivation questionnaire in Physics (SMQP) developed on five points Likert's scale with a reliability coefficient of 0.537. Data collected were analyzed using mean and standard deviation, t-test, ANOVA, Mann-Whitney and Kruskall Wallis statistics. The results revealed that there was significant difference in the level of motivation of students taught using PI and JiTT teaching strategies than their counterpart in the control groups. The result further

showed that there was no significant difference in the level of motivation between male and female students taught using the teaching strategies. This study is related to the present study in terms of motivation, instrumentations for data collection and analyses. It differs in terms of sampling technique, concepts taught and method of instructional approach on students' performance.

Adedeji (2007) investigated the impact of motivation on students' academic performance in learning outcomes in mathematics among secondary school students in Ibadan, Nigeria. The study adopted ex-post facto research design. The population of study comprises all senior secondary school II students in Ibadan North-West and South- West Local Government Areas. Simple random sampling technique was used to select 450 students drawn from 10 schools in the local government areas. A modified tagged Motivation for Academic Performance Questionnaire (MAPQ) with reliability coefficient of 0.82 was used to collect data. The data collected was analyzed using t-test, and ANOVA. The result showed gender difference was significant when impact of motivation and academic performance were compared between male and female students. This study is related to the research investigated in students' motivation and performance. It differs in terms of research design, method of instructional approach, subject area as well as instrument for data collection and data analyses.

Kumar and Sagar (2015) conducted a research on the academic achievement of socially disadvantaged secondary school students in relation to achievement motivation in Panckula, India. The study used descriptive survey research design. The population of the study comprised of all secondary school students of VIII and IX in Panckula. A total of 200 secondary socially disadvantaged students were sampled which comprises 100 male

and 100 female from 10 secondary schools in Panckula. Achievement Motivation Scale (AMS) was used to collect data. The statistical tools used to compute the data collected were t-test and Pearson product correlation. The result showed that there was significant difference in academic motivation of male and female students. The study is related to the research investigated in terms of motivation and performance. It differs in research design, instructional approach, instrumentation, geographical location as well as method of data analysis.

Wambugu and Changeiywo (2008) determined the effects of mastery learning approach on secondary school students' performance. The researchers used quasi-experimental involving Solomon four non-equivalent control group design. The population of the study used comprises of secondary schools in Keini East Division of Nyeri District, Kenya. Purposive sampling technique was used to obtain a sample of 161 students from four co-educational secondary schools. The concepts taught were Equilibrium and Centre of Gravity .The instrument used in the study was Physics Performance Test (PPT) with a reliability coefficient of 0.76. Data collected was analyzed using t-test, ANOVA and ANCOVA. The result of the study revealed that MLA teaching method resulted in higher performance but gender had no significant influence on their performance. This study is related to the present research in terms of instructional approach on students' performance. It differs in terms of research design, sampling technique, motivation, concepts taught, data collection procedure as well as geographical location where the research was conducted.

Wanjau (2014) investigated the effects of mastery learning approach on secondary school students, motivation and achievement in Kiswahili in Maraigushu Zone of Naivasha Sub-

County, Kenya. The researcher used Solomon four non- equivalent control group design. The accessible population was Form Two co-educational schools in the district. The sample comprised of 169 students from four secondary schools obtained through purposive sampling technique. Random assignment was used to place the schools in experimental and control groups. The experimental groups were taught Kiswahili using MLA while the control groups were taught using regular teaching method (RTM). Two instruments namely; Kiswahili achievement test (KAT) and students' motivation questionnaire (SMQ) were used for data collection. A reliability coefficient of 0.8723 was obtained for KAT and 0.8074 for SMQ respectively. The data collected was analyzed using ANOVA, ANCOVA and t-test. Findings of the study indicated that MLA enhances achievement and motivation of students in Kiswahili. The results further indicated that there was no significant difference in the level of motivation between male and female students taught using MLA. This study is related to the present study under investigation in terms of instructional strategy on students' motivation and performance, and instrumentations for data collection. It differs in subject area, geographical location where the research was conducted and method of data analyses.

Keraro, Wachanga, and Orora (2007) investigated the effects of cooperative concept mapping teaching approach on secondary school students' motivation in Biology in Gucha district, Kenya. A non-equivalent control group design under quasi- experimental research was used. The target population for the study was all co-educational secondary schools in Gucha district. Random sampling of four secondary schools comprising 156 second grade students' cycle (form two students) formed the sampled. Students in all the groups were taught the same Biology content but two groups, the experimental groups

were taught using the CCM approach while the other two, the control groups were taught using regular teaching method (RTM). Biology achievement test (BAT) was used to collect data. Data collected were analyzed using t-test, ANOVA and ANCOVA. The results showed that there was no significant gender difference in motivation towards the learning of Biology among secondary schools exposed to CCM. This research is similar to the present study on students' motivation and performance. It differs with the present study in the subject area where the research was conducted, method of instructional approach and procedure for data analyses.

Yusuf and Mohammed (2017) examined academic motivation and performance of junior high school students in Cape Coast, Ghana. The study adopted survey research design. The population of the study comprised of all 24 junior high schools in Cape Coast. Stratified random sampling technique was used to select 756 male 714 female junior high school 2 students. Two research instruments; Achievement Scale Motivation Questionnaire (AMS) with Cronbach Alpha reliability coefficient of 0.75 and Achievement Tests in Mathematics, English Language, Social Studies and Integrated Science were used to collect data. Pearson product moment correlation coefficient and t-test were used to analyze the data. The result showed significant difference between the academic motivation of male and female students. The study is related to the research investigated in terms of motivation and performance. It differs in terms of instructional approach, research design, subject area, school level, geographical location where the research was conducted, instrumentation and method of data collection and analyses.

Badola (2013) conducted a study on the academic performance and motivation of secondary schools students in Garhwal U.K. The population of the study consisted of 480

students. The data was collected using academic performance motivation test (APMT). The data was analyzed using analysis of variance (ANOVA). The result showed that there was significant difference among government, public and convent schools on their academic performance motivation. Insignificance difference was found between public and convent school students on their academic performance motivation. This study is related to the present study in terms of students' motivation and academic performance. It differs in instructional approach, research design sampling technique and instrumentations for data collection and analyses.

Baliiel, Duran and Bilgili (2011) carried out a research work on the effect of teaching the unit space puzzle by using field-trip observation method in science and technology course on the seventh grade students' performance, motivation and attitude. The study consists of 62 students from Milas district of Magla city. The instruments used for data collection was motivation and learning strategies questionnaire (MLSQ). Multiple analyses of variance were used to analyze the data. The findings revealed that field trip observation method was influential on students' motivation in relation to internal target regulation and perception of self-efficacy for learning and performance. This study is related to the present study on students' motivation and performance. It differs in instructional approach, research design, sampling technique, instrumentations for data collection and procedure for data analyses

Malik and Jamil (2012) worked on the effect of motivation and parental influence on the educational attainment of students at secondary level in Pakistan. The population of the study consisted of all 9^{th} and 10^{th} class secondary school students in Dera Ismail Khan, KPK, Pakistan. A sample of 400 students from 8 different schools was taken. 20 items

questionnaire was used to measure students' level of motivation and parental influence. Simple correlation was used to analyze the result. The result indicated that there was strong correlation between parental influence, motivation and academic performance. This study is related to the present research in terms of students' motivation and performance. It differs in terms of instructional approach and method of data analyses.

Based on the reviewed literature available to the researcher so far, specific study of MLA on students' motivation and performance in Physics are limited. Therefore, it is on this basis that this research work investigated the Impact of Mastery Learning Approach on Motivation and performance in Wave Concepts among Senior Secondary School Students in Zaria, Kaduna state Nigeria.

2.10 Implication of Literature Reviewed for the Present Study

The literature reviewed in this study has some implications for the present study. For quite a long time, science teachers have been searching for effective instructional strategies and fruitful curriculum materials that would collectively foster the teaching and learning of science to younger generation (Johnson & Johnson 2000). Literature reviewed such as Wambugu and Changeiywo (2008), Achufusi and Mgbemena (2012), Agboghoroma (2014) and Mitee and Obaitan (2015) have shown enhancement in students' academic performance using MLA. Similarly, literature reviewed on motivation such as Malik and Jamil (2012), Badola (2013), Wanjau (2014) and Haruna (2016) revealed that motivation of students is very important for better output in the academic pursuit.

The findings of Wambugu and Changeiywo (2008) on the effects of MLA on secondary school students' performance in Physics in Keini East Division of Nyeri, Kenya

confirmed that MLA resulted in higher performance. In their study, MLA and students' performance were considered as variables of interest. This research is unique from theirs as motivation was introduced to enhanced students performance using MLA. More so, the findings of Achufusi and Mgbemena (2012) on the effects of MLA on academic performance of SSII Physics students in Ogidi Education Zone of Anambra State indicate significant effect on students' performance. In their study, MLA and academic performance were considered as variable of interest .Their study differs from this research because motivation as variable of interest to the researcher was used to enhanced students' performance. Similarly, the findings of Wanjau (2014) on the effect of MLA on students' motivation and performance in Kiswahili in Maraigushu Zone of Naivasha Sub-County, Kenya revealed that MLA promote students motivation to enhance academic performance. In his study, MLA and motivation was used to enhance students' performance in Kiswahili language. In this study, MLA and motivation was also used as variable of interest to enhanced students performance in Physics as one of the science subject using wave concepts. As such, this study discovered a gap from the reviewed literature in terms of geographical location, subject area, concepts taught and motivation a variable of interest to the researcher as it was used to determined the impact of MLA on motivation in wave concepts among senior secondary school Physics students to enhance academic performance in Zaria Kaduna, Nigeria. Hence, this study filled this gap.

Besides, educational psychologists are of the view that students' motivation is an indispensable requirement for efficient learning and in the event of insufficient motivation to learn, the outcome of such learning will be unsatisfactory. Students' motivation affects every aspects of school life, from attendance, interest, academic

performance to extracurricular activities. Promoting the greatest students' motivation possible is extremely important for every Physics teacher especially in today's educational climate where schools are continuously under pressure to improve test scores, responsibility and accountability (Baranek, 1996). Because of the relevance of motivation on students' performance and the fact that most research only investigates on the effects of MLA on students' performance in different subject areas based on the literature available to the researcher. But little has been done to ascertain the impact of MLA on motivation to enhance academic performance in wave concepts among senior secondary school Physics students in Zaria, Kaduna state, Nigeria based on the literature available to the researcher. This study therefore, investigated the Impact of MLA on Motivation and Performance in Wave Concepts among Senior Secondary School Physics Students, in Zaria, Kaduna State, Nigeria.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This study is designed to find out the Impact of Mastery Learning Approach on Motivation and Performance in Wave Concepts among Senior Secondary School Students in Zaria, Kaduna State, Nigeria. This chapter contains a discussion of the method that will be used in carrying out this study. This is presented in the following sub-headings

3.2 Research Design

3.3 Population of the Study

3.4 Sample and Sampling Procedure

3.5 Instrumentation

3.5.1 Validation of the Instruments

3.5.2 Pilot Testing

3.5.3 Reliability of the Instrument

3.5.4 Items Analysis

3.6 Administration of Instrument

3.7 Procedure for Data Collection

3.8 Procedure for Data Analysis

3.2 Research Design

A pretest, posttest quasi- experimental control group research design was used for the study. Two groups of students participated in the study; experimental group (EG) and control group (CG). A pretest was administered to the groups in order to determine the equivalence of the groups in their ability levels before the administration of the treatment. The experimental group was taught using Mastery Learning Approach (MLA), while the control group was taught the same concept using lecture method. A post test was administered at the end of the period to all the groups to determine the impact of MLA on students' motivation and performance in Physics. The design of the study is represented in Figure 3.1

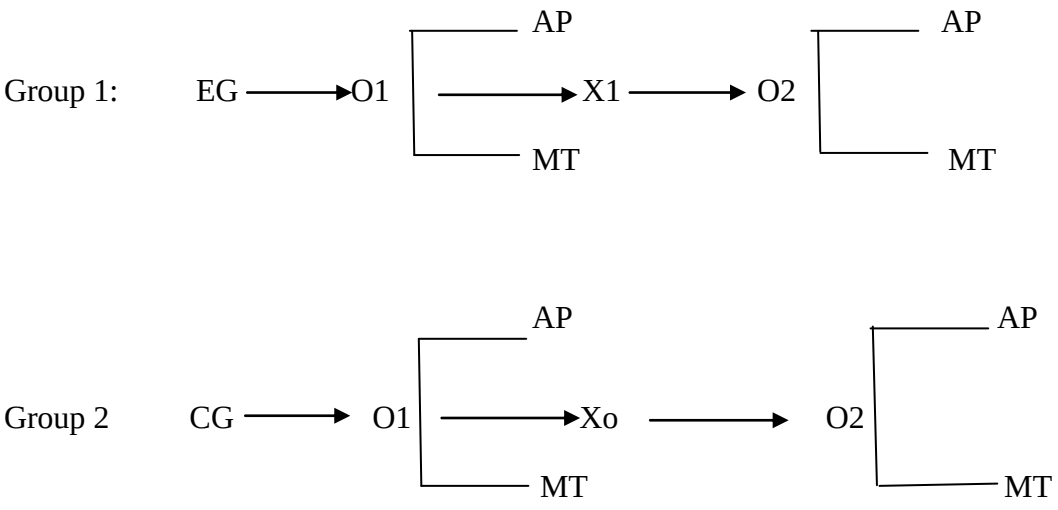


Fig 3.1: Research Design

Source: Researcher

Where,

EG: Experimental group

X1: Treatment Group

CG: Control Group

XO: No treatment

O1: Pretest administration

O2: Posttest administration

AP: Performance

MT: Motivation

3.3 Population of the Study

The target population for this study was drawn from public senior secondary schools students (SSII) in Zaria Education Zone who were offering Physics. Available data revealed that there were nine public senior secondary schools owned by State Government which were co-educational, with a total Physics students' population of 304 (188 male and 116 female) students with an average age of 17 years. Below (Table 3.1) is the breakdown of the students' population according to schools in the study area.

Table3.1: Population of the Study

S/N	Name of School	Type of School	Male	Female	Total
1	G.S.S.S kaura	Co-Ed	25	17	42
2	G.S.S T/Jukun	Co-Ed	23	10	33
3	G.S.S Gyellesu	Co-Ed	24	17	41
4	G.S.S K/ Kuyan bana	Co-Ed	20	14	34
5	G.S.S Magajiya	Co-Ed	25	15	40
6	Karau-Karau B	Co-Ed	22	16	38
7	G.S.S Dakace	Co-Ed	27	12	39
8	G.S.S Kugu	Co-Ed	16	13	29
9	G.S.S Bogari	Co-Ed	06	_	06
	Total		**188**	**116**	**304**

Source: Zaria Education Zone (2016)

3.4 Sample and Sampling Technique

Simple random sampling Technique by hat and draw method was used to select four schools out of nine co-educational senior secondary schools of the population. The four schools were G.S.S Magajiya,, G.S.S Dakace, G.S.S T/Jukun and G. S.S K/Kuyan bana. However, these schools were pretested using Physics Academic Performance Test (PAPT) for the purpose of comparability of ability level and the result was analyzed using Analysis of Variance (ANOVA) statistics and Scheffe's test of ANOVA result to choose a pair of school that have no significant difference in their academic performance. From the result analyzed, two schools showed no significant difference and were therefore selected (see AppendixVII). To determine which school serve as experimental and control group, a simple balloting of pick one out with eyes closed was used. Thus, G.S.S. T/Jukun was picked and assigned experimental while G.S.S K/Kuyan Bana was left and assigned control group. Therefore, the study consists of 67 students selected from the two schools which were viable for the study (33-experimental and 34-control groups). The choice of 67 students is in line with the central limit theory which according to Tuckman (1975), suggested that minimum of 30 participants can be use to establish a relationship between groups in an experimental research of this kind. The detail of the sample for the study is presented in Table 3.2.

Table 3.2: Sample for the Study

S/N	Name of Schools	Group	Males	Females	Total
1	School A	Experimental	23	10	33
2	School B	Control	20	14	34
	Total		**43**	**24**	**67**

3.5 Instrumentation

In this study, two instruments were used for data collection. These are:

1. Physics Academic Performance Test (PAPT) and
2. Students' Motivation Questionnaire (SMQ)

3.5.1 Physics Academic Performance Test (PAPT)

The Physics Academic Performance Test (PAPT) is a 40-items multiple choice test with four distracters or options developed by the researcher from WAEC past questions to measure students' academic performance in Wave concepts. The test consists of two sections. Section A; Bio data and section B; Physics Performance Test. The total mark awarded for the test is 40. The detail of the items specification based on Bloom's cognitive domain on topics selected for PAPT are Presented in Table 3.3 and 3.4 respectively.

Table 3.3: Item Specification for PAPT Based on Bloom's Cognitive Domain

Content Weight(%)	**Knowledge (27.5)**	**Comprehension (20)**	**Application (20)**	**Analysis (10)**	**Synthesis (10)**	**Evaluation (12.5)**	**Total (100)**
1.Conceptof Waves(15)	2	2	1	0	0	1	6
2.Types of Waves(25)	3	2	2	1	1	1	10
3.Properties of Waves(25)	2	2	3	1	1	1	10
4.Light and Sound waves (20)	3	1	1	1	1	1	8
5.Simple Calculations Involving Waves(15)	1	1	1	1	1	1	6
Total(100%)	**11**	**8**	**8**	**4**	**4**	**5**	**40**

Source: Researcher (2017)

Table 3.3 shows the distribution of questions for PPT construction taking into consideration the six educational taxonomy of bloom, such that knowledge has 11 questions, comprehension has 8 questions, application has 8 questions, synthesis has 4 questions, and 5 questions for evaluation.

Table 3.4: Summary of Items Specification for PAPT Based on Topics Selected

S/No	Topics	Number of Items	Total
1	Concept of waves	1,2,3,4,10,11,12,13,15,16,17,18,34 and 35	14
2	Types of waves	5,6,7,8,9,14 and 33	7
3	Properties of waves	19,20,21,25 and 38	5
4	Light and sound waves	26, 27, 28, 29, 36, 39 and 40	7
5	Simple calculations in waves	22, 23, 24,30,31,32 and 37	7
	Total		**40**

Table 3.4 shows the number of questions each sub-topic has. Concept of waves has 14 items, types of waves 7 items, properties of waves 5 items, light and sound waves 7 items and simple calculations in waves has 7 items, making a total of 40 items.

3.5.2 Students Motivation Questionnaire (SMQ)

The Students Motivation Questionnaire (SMQ) is a 28-Items questionnaire adopted from Changeiywo, Wambugu and Wachanga (2011). It consists of two sections. Section A; bio data and section B; items on students motivation. Student Motivation Questionnaire (SMQ) is a 28 item questionnaire adopted from Changeiywo, Wambugu and Wachanga (2011). The items were constructed based on Keller's ARCS motivation theory (Hohn, 1995). The Acronyms ARCS stands for the four conditions that must exist in a motivated learner. These are attention, relevance, confidence and satisfaction. The items were

constructed on five points likert's scale having responses of Strongly Disagree (SD), Disagree (D), Undecided (U), Agree (A), and Strongly Agree (SA) respectively.

3.5.1 Validation of the Instruments

3.5.1.1 Validation of Physics Academic Performance Test (PAPT)

In order to determine the extent to which the instruments designed for data collection can measure the performance of students in Physics, the instruments was validated by two experts each in the Department of Physics and Science Education, Ahmadu Bello University, Zaria, with Qualification of PhD and are of the rank of senior lecturer and above. This is also in addition to the initial validation of the instrument by supervisory team. The experts were requested to critically examine and assess the entire test items with respect to the following terms:

- Whether the contents of the instruments are correct and appropriate,
- Whether the items are precise and clear from ambiguity, and
- Suggest appropriate corrections on the possible errors observed in the instruments.

Based on the feedback from the validations, the face and content validity of the test items were found to be within the ability level of the students, free from ambiguities and has covered the study area. It means that the instruments were within the ability levels of the students and were able to measure up what was expected. Hence, the items in the instrument were found to be satisfactory by all the experts. Due to their impacts, some of the questions were restructured and the 40 items were retained. For example, five (5) multiple choice questions were restructured to fill in the blank space. The initial plan of

the researcher was completely multiple choice questions. Time duration for the PAPT was also emphasized.

3.5.1.2 Validation of Student Motivation Questionnaire (SMQ)

This instrument, Student Motivation Questionnaire is a 28 item questionnaire adopted from Changeiywo, Wambugu and Wachanga (2011) was validated by one expert in the department of Educational Psychology, Ahmadu Bello University, Zaria, with qualification of PhD and of the rank of senior lecturer. This is also in addition to the initial validation of the instrument by the supervisory team. The expert was requested to check for possible errors in the instrument, certify if the questions are testing the motivation of students and if the items are appropriate for the level of students under study. The instrument was found to be satisfactory and appropriate for the study.

3.6 Pilot Testing

This instrument, Physics Academic Performance Test (PAPT) was pilot-tested on SSII Physics students of Government Secondary School Gyellesu. This is one of the schools that formed the population of study. Thirty students comprising of 17 boys and 13 girls participated in the pilot testing. The essence of the pilot testing is to find out how the respondents react to the instrument and to determine the characteristics of the test items which include reliability, facility and discrimination indices. The length of time taken for students to respond to the test item (PAPT) was also determined. For instance, the first student to finish the test used about forty five minutes while the last student to submit used about 1 hour (1hr), hence the duration for the PAPT test was fixed at one hour (1hr).

3.6.1 Reliability of the Instruments

3.6.1.1 Reliability of Physics Performance Test (PPT)

Test-retest method was used to determine the reliability coefficient of PAPT. The instrument was administered twice on the same group of students that were pilot tested at two weeks interval as recommended by Tuckman (1979). The result obtained was analyzed using Pearson product moment correlation (PPMC). The reliability of PAPT was computed to be 0.89

3.6.1.2 Reliability of Students Motivation Questionnaire (SMQ)

The instrument (SMQ) was adopted from Changeiywo, Wambugu and Wachanga (2011). The adopted reliability coefficient of the instrument (SMQ) was 0.76 which was determined using Cronbach's Alpha statistical tool with the aid of SPSS. An alpha value of 0.7 and above is considered suitable to make group inferences that are accurate enough (Graham, 2006). This suggests a positive reliability and the instrument is reliable to measure the motivation of the students.

3.6.2 Items Analysis

For the purpose of standardization of the instrument Physics Academic Performance Test (PAPT), facility index and discrimination index were determined as follows:

3.6.2.1 Facility Index

The facility index of an item shows the percentage of candidates that got an item first (Furst, in Bichi, 2002). The following are the steps followed in calculating the facility index for each item in the test, viz:

I. Rank the scores on the test from highest to lowest

II. Identify the high scoring group and the low scoring group.

III. Identify one third of the top scoring group and the one third of the bottom scoring group,

IV. Determine the percentage of high scores and low scores of each item.

V. Calculate the item facility index by adding the percentage of those that got the item correct in low scoring and high scoring and then divide by the number of students involved in the entire test.

The formula is F.I = $\frac{U + L}{N}$

F.I. = Facility index

N = Number of students involved in the analysis

U = Number of students who passed the item in the upper percent

L = Number of students who passed the item in lower percent

Facility index of 75% or higher is regarded as easy in terms of facility level, whereas an index of 25% or less is regarded as hard in terms of facility level. For this study, Physics Academic Performance Test [PAPT] with facility index 0.30 - 0.69 which is in line with

Mugenda and Mugenda (2003) opined that facility index within the range of 0.30 to 0.70 can be adopted and this was adopted for this research work.

3.6.2.2 Discrimination Index

The discrimination index of a test is a measure of its ability to discriminate between high and low achievers as a whole (Furst, in Bichi, (2002). This was used to identify high and low achieving students. The difficulty index of test items is its ability to separate or sort out high and low ranking students in a test. The calculation was done using scores of the top twenty seven percent (27%) and bottom twenty seven percent (27%) of the total respondents. This was calculated using the formula given by Furst in Bichi, (2002).

$$D_1 = \frac{RU - Ri}{\frac{1}{2}N}$$

Where D = discrimination index

Ru = Number among upper 27% of respondents

Ri = Number among lower 27% of respondents

N = total number of respondents

According to the author, items showing little or no difficulty or items that show a percentage of success in part of the poor group should either be re-examined or eliminated for ambiguity and vagueness of such item should be re-worded.

Discrimination index for each item was calculated by subtracting the number of subjects in the lower group who got the item correctly from the number of students in upper group

who got the item correctly. The figure was divided by half number of students in both groups by the number of students in one of the groups. The discrimination index which ranges between 0.30 and 0.60 is regarded as moderately positive and is accepted for the present research work. This was used in selecting the final items of the PAPT. (See Appendix).

3.7 Administration of Treatment

Mastery learning approach was observed as the treatment. The treatment was conducted by the researcher and a trained Physics teacher as research assistant in the school. This enabled the researcher to effectively handle the treatment following all the necessary criteria for the adoption of the approach. The wave concepts taught were divided into sequential learning units for six weeks. Each learning unit was taught for 120 minutes (triple period). Inquiry and discussion methods were used to teach the lessons. In each learning unit, formative assessment was conducted to provide feedback to the students. Enrichment activities were also given to the students that achieved mastery of unit taught inform of problem solving and additional assignments. Remediation inform of re-teaching by adopting alternative method was ensured to the students that required more help to achieve mastery. After the corrective activities, second formative assessment was administered to determine the effectiveness of the corrective instruction.

This process was employed for all the remaining learning units which last for six weeks. After the six weeks of treatment, posttest was administered to the students to determine the impact of mastery learning approach on students' motivation and performance. The steps for the treatment are as follows:

i. The concepts and materials the students are to learn are first organized into instructional units. A unit is composed of the concepts presented in about a week or two of instructional time.

ii. Initial instruction on the unit by adopting suitable methods.

iii. A quiz or assessment is given to students for giving students information or feedback on their learning. Bloom called it 'formative assessment'.

iv. Enrichment activities is given to students that mastered the unit taught

v. Suggestions to students as to what they might do to correct the learning difficulties identified on the assessment. Correctives are individualized and students need to work for the mastery of non-mastered concepts. They may point out additional sources of information on a particular topic, such as the page numbers in the course textbook or workbook where the topic is discussed. They may identify alternative learning resources such as different textbooks, alternative materials, learner centered activities, or computerized instructional lessons, or they may simply suggest sources of additional practice, such as study guides, independent practice or guided practice activities.

vi. Administration of a parallel formative assessment when the students complete their corrective activities usually after a class period or two. The treatment flowchart is presented in Figure 3.2.

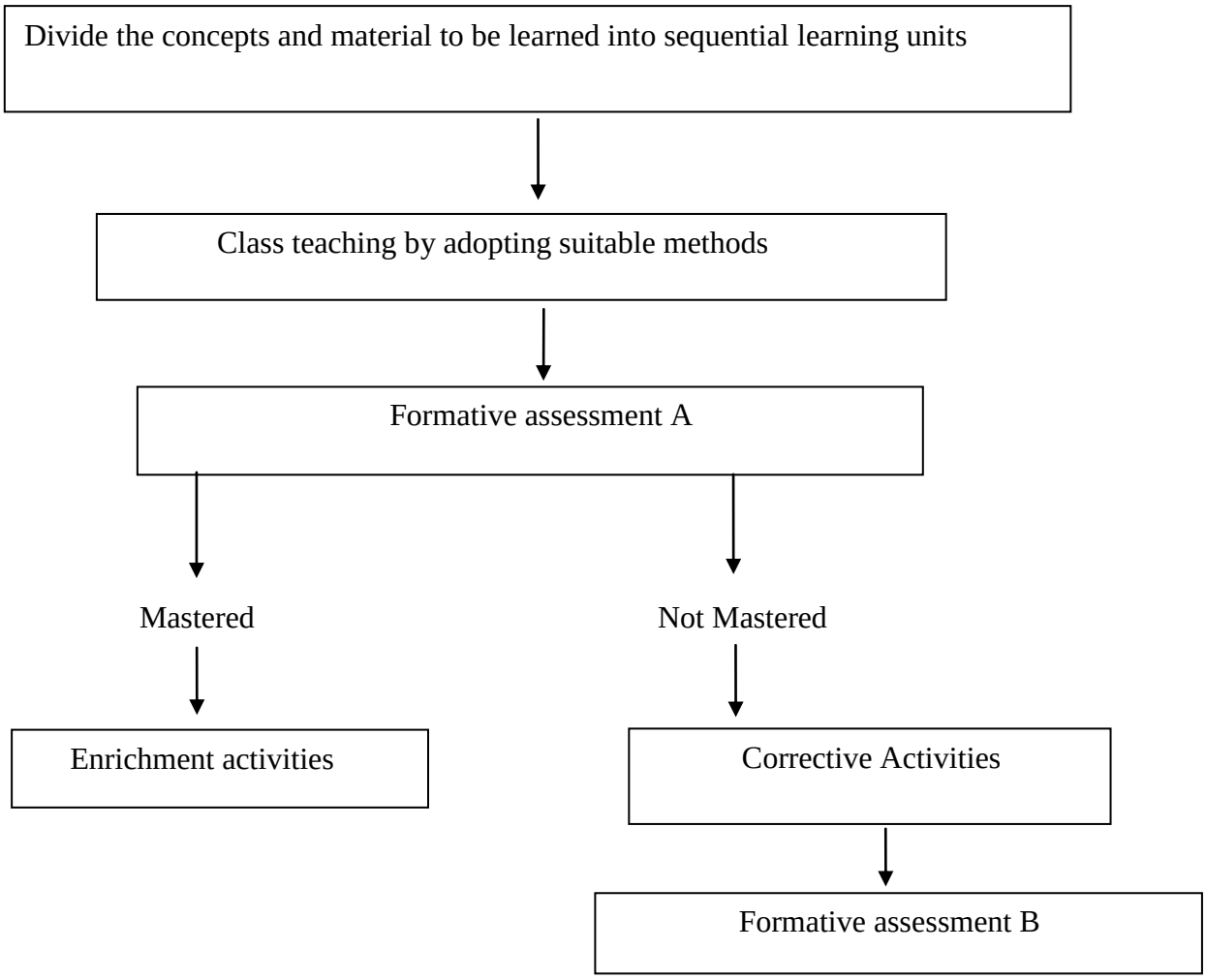


Figure 3.2: Treatment Flowchart for Mastery Learning Approach

Source: Adopted from Bloom (1968)

3.9.1 Teaching the Control Group

The teaching of the control group was conducted by the researcher using lecture method. Prior to the actual teaching, pretest was administered to the group to determine their entry behaviour on the concept of waves and to ensure that they are not significantly different in abilities. Each lesson last for 80 minutes per week for six weeks. In each lesson, the

objectives were clearly stated. In the content delivery, the lessons presentations were verbal communication of the wave concepts to the students and were not given any form of motivation. At the end of the sixth week, posttest was administered to measure students' performance with PAPT. Students Motivation Questionnaire was also administered to determined their level of motivation

3.8 Procedure for Data Collection

For the purpose of data collection, the following sequential was used. The Physics Academic Performance Test (PAPT) was administered to the students as pretest to determine class equivalence and posttest to determine their performance after. Student Motivation Questionnaire (SMQ) was also administered to measure the students' level of motivation. The data was collected after marking the students' answer scripts. The scores was computed for experimental and control groups.

3.9 Procedure for Data Analyses

The data collection was subjected to analyses at two different levels, that is, descriptive and inferential levels. At the descriptive level, the descriptive statistics of mean and standard deviation were used to answer to research questions. While at the inferential level, t-test and Mann-Whitney U-test were used to test the null hypotheses at the significance level of $P \leq 0.05$. The inferential statistics level forms the basis to permit decision making on whether to reject or retain the null hypotheses after being tested.

H01: There is no significant difference between the mean scores of students taught using mastery learning approach and those taught using lecture method

H01 is tested using paired comparative samples t-test statistics

H02: There is no significant difference between level of motivation of students taught using mastery learning approach and those taught using lecture method.

H02 is analyzed using Mann-Whitney U-test

H03: There is no significant difference between the performance of male and female students taught using mastery learning approach.

H03 is tested using independent sample t-test statistics

H04: There is no significant difference between level of motivation of male and female students taught using mastery learning approach.

H04 is tested using Mann-Whitney U-test.

CHAPTER FOUR

DATA ANALYSIS, RESULTS AND DISCUSSION

4.1 Introduction

This study investigates the impact of Mastery Learning Approach on Motivation and Performance in Wave Concepts among senior secondary school Physics students in Zaria, Kaduna State. This chapter contains data analysis, result and discussion. The results are presented according to the research questions and hypotheses which guided the study. Specifically, the chapter has the following sub-headings:

- Analysis and Results Presentation
- Summary of Major Findings
- Discussion of Results

4.2 Data Analysis and Results Presentation

4.2.1 Answering the Research Questions

The four research questions raised were answered using descriptive statistics. Means and standard deviations were used in answering the research questions, except for the second research question, where mean rank and sum of ranks were used.

Research Question one: What is the difference between the mean scores of students taught using mastery learning approach and those taught using lecture method?

The mean and standard deviation of post test scores of experimental and control groups are calculated and presented in Table 4.1

Table 4.1: Means and Standard Deviations of Post Test Scores of PAPT for Experimental and Control Groups

Group	N	Mean	Standard Deviation	Mean Difference
Experimental	33	24.29	1.62	
				1.41
Control	34	22.88	3.71	

Table 4.1 shows that the experimental group has a mean score of 24.29 and standard deviation of 1.62, while the control group has a mean score of 22.88 and standard deviation of 3.71 and a mean difference of 1.41. This shows that Physics students taught Wave Concepts using Mastery Learning Approach achieved higher academically by mean score of 24.29 than lecture group counterpart with mean score of 22.88.

Research Question Two: What is the difference between level of motivation of students taught using mastery learning approach and those taught using lecture method?

Here, the mean rank of students post motivation scores in the experimental and control groups were compared and presented in Table 4.2

Table 4.2: Mean Rank Motivation Scores of SMQ for Experimental and Control Groups

Group	N	Mean Rank	Sum of Rank	Mean Rank Difference
Experimental	33	48.74	1608.50	
				29.04
Control	34	19.69	669.50	

From Table 4.2, the mean rank value of 48.74 was obtained in the experimental group with a value of 1608.50 as the sum of rank; while in the control group, a mean rank value of 29.04 with a sum of rank of 669.50 was also obtained. A high mean rank difference of 29.04 was computed and this shows that the experimental group developed a higher motivation than the control group.

Research Question Three: What is the difference between the performance of male and female students taught using mastery learning approach?

To answer this question, means and standard deviation of post test scores generated via PAPT for male and female students in the experimental group were computed and used to draw Table 4.3.

Table 4.3: Means and Standard Deviations of Post Test Scores of PAPT for Male and Female in Experimental Group

Group	N	Mean	Standard Deviation	Mean Difference
Male	23	24.20	1.64	
				0.20
Female	10	24.40	1.63	

Result in Table 4.3 shows that the mean post test scores of male students in the experimental group is 24.20, with standard deviation of 1.64. Likewise the female students in the experimental group also have a mean score of 24.40 with standard deviation of 1.63. A mean difference of 0.20 was observed. This shows that both male

and female students taught Wave Concepts using Mastery Learning Approach have almost similar mean academic score in their post test.

Research Question Four: What is the difference between level of motivation of male and female students taught using mastery learning approach?

Means and standard deviations of students' motivation score of male and female in experimental group were computed and presented in Table 4.4

Table 4.4: Mean Rank Motivation Scores for Male and Female Students in Experimental Group

Group	N	Mean Rank	Sum of Rank	Rank Difference
Male	23	17.54	403.50	
				1.79
Female	10	15.75	157.50	

Table 4.4 shows the mean rank motivation score for male students in the experimental group as 17.54 and a sum of rank of 403.50, while that of the female students revealed a mean rank motivation score of 15.75 and a sum of rank 157.50. The rank difference computed was 1.79. This implies that both male female students in the experimental group have almost the same mean motivation score. Hence, Mastery Learning Approach is effective in improving motivation level of male and female students.

4.2.2 Testing Null Hypotheses

H01: There is no significant difference between the mean scores of students taught using mastery learning approach and those taught using lecture method

Comparative sample t-test was used to test hypothesis 1 using data of test scores of students in experimental and control groups. The result of the analysis is presented in Table 4.5

Table 4.5: Results of t-test Analysis of Post PAPT Scores of Students in Experimental and Control Groups.

Group	N	Mean	S.D	df	t-cal	P	Decision
Experimental	33	24.29	1.62	65	2.18	0.03	Sig*
Control	34	22.88	3.71				

*Significant at P≤ 0.05 level of significance

Table 4.5 shows that the t-cal computed is 2.18 and the P-value of 0.03 is observed at degree of freedom of 65. Since the P-value of 0.03 is less than the alpha value of 0.05, there is significant difference in the academic performance of the students in the experimental when compared to the control groups. This null hypothesis is rejected. The significance difference is in favour of the experimental group taught using mastery learning approach as revealed in the mean scores. This implies that the experimental

group performed significantly better academically than the control group. Hence, mastery learning approach is more effective the than lecture method.

H02: There is no significant difference between level of motivation of students taught using mastery learning approach and those taught using lecture.

Mann-Whitney U-test was used to test this hypothesis using post motivation ranking of the students in both experimental and control groups. The details of the result is presented in Table 4.6

Table 4.6: Results of Mann-Whitney U-test Analysis of Motivation Scores of Students in Experimental and Control Groups

Group	N	Mean rank	Sum of Rank	U-test	P	Decision
Experimental	33	48.74	1608.50			
				74.00	0.001	Sig*
Control	34	19.69	669.50			

*Significant at P≤ 0.05 level of significance

Results in Table 4.6 shows that the rank of mean 48.74 was obtained by the experimental group and a sum of 1608.50. On the other hand, the mean rank value of the control group was 19.69 and the sum of rank was 666.50. The Mann -Whitney U-value was 74.00. Since the P-value of 0.001 is less than 0.05, there is significant difference between the motivation level of students in the experimental and control groups in favour of the experimental group who were taught using MLA. Hence, the null hypothesis is rejected. This implies that MLA enhances students' motivation than lecture method.

H03: There is no significant difference between the performance of male and female students taught using Mastery Learning Approach.

To test H03, post test scores of male and female students in experimental group generated via PAPT were subjected to t-test statistics. Summary of the analysis is shown Table 4.7

Table 4.7: Summary of t-test Analysis of Post PPT Scores of Male and Female Students in the Experimental Group.

Group	N	Mean	S.D	df	t-cal	P	Decision
Male	23	24.20	1.64				
				31	-0.36	0.72	Not Sig*
Female	10	24.40	1.63				

*Not Significant at P≤ 0.05 level of significance

From the results in Table 4.7 it is clear that the t-cal of -0.36 is obtained and a P-value of 0.72 at the degree of freedom of 31. The P-value of 0.72 is greater than the alpha value of 0.05. Hence, this null hypothesis is retained. This means that there is no significant difference in the academic performance of male and female students taught using Mastery Learning Approach. This also implies that MLA is effective for improving the performance of both male and female students. Mastery Learning Approach is found to be gender friendly.

H04: There is no significant difference between level of motivation of male and female students taught using Mastery Learning Approach.

In testing hypothesis four, data of post motivation scores of male and female students of experimental group were used. The independent sample t-test was used to analyse the data. Summary of the analysis is shown in Table 4.8

Table 4.8: Results of Mann-Whitney U-test Analysis of Post Motivation Scores of Male and Female Students in Experimental Group.

Group	N	Mean Rank	Sum of Rank	df	U-test	P	Decision
Male	23	17.54	403.50				
				31	102.50	0.62	Not Sig*
Female	10	15.75	157.50				

*Not Significant at P≤ 0.05 level of significance

From the results in Table 4.8, it is observed that the mean rank score of male is 17.54 and that of female is 15.75. The mean rank difference is 1.79 in favour of the experimental group. Since the P- value of 0.62 is greater than the alpha value of 0.05. Hence, the null hypothesis is retained. Therefore, there is no significant difference between the motivation level of male and female students taught using mastery learning approach. This is also supported by U=102.50. This implies that MLA is effective in enhancing the motivation level of both male and female students

4.3 Summary of Findings

From the results presented in this study, the summary of the major findings are:

1. There is significant difference in the academic performance scores of Physics students taught using mastery leaning approach and those taught using lecture method. Student in the experimental group performed better than those in the control group.

2. There is significant difference in the motivation level of the students taught using mastery learning approach and those taught using lecture method. The significant different is in favour of mastery learning approach group.
3. There is no significant difference in the academic performance of male and female Physics students taught using mastery learning approach.
4. There is no significant difference in the motivation level of male and female Physics students taught using mastery approach.

4.4 Discussion of Results

The data generated from this study were analysed and the results were presented in section 4.2. This section deals with the discussion of results according to the sequence of the hypotheses.

From the findings in Table 4.5, the study revealed that experimental group recorded the highest mean score than the control group which shows that there is a significant difference between the academic performance of students taught using mastery learning approach when compared with those taught using lecture method. This finding is supported by Wambugu and Changeiywo (2008), Achufusi and Mgbemena (2012), Agboghoroma (2014), Lamidi, Oyelekan and Olorundane (2015), Oluwatosin and Bello (2015) and Mitee and Obaitan (2015). Wambugu and Changeiywo (2008) found out that the students taught Physics using mastery learning approach achieved significantly higher than those taught using lecture method. The work of Mgbemena (2012) also showed a significant difference between the mean performance scores of student taught using mastery learning approach and those taught using lecture method

in favour of those taught with MLA. This study also find support in the work of Agboghoroma (2014) which revealed that students taught integrated science concept using MLA favoured the MLA as they performed better than their counterpart in the lecture method. In this study, the observed significant difference in students' academic performance could be as a result that MLA is an activity based approach which actively involves the students in classroom teaching and learning.

Table 4.6 compared the motivation level of the students in the experimental and control group. From the findings of these Tables, results revealed significant difference in the motivation level of the students exposed to MLA and lecture method. The significant difference is in favour of experimental group as revealed in the mean rank value, mean value and U-value. This findings is in agreement with Adedeje (2007), Keraro Wachanga and Orora (2007), Baliiel, Duran and Bilgili (2011), Badola (2013), Wanjau (2014) and Haruna (2016). Also Keraro, Wachanga and Orora (2007) in their work revealed that Cooperative Concept Mapping teaching approach have significant effect on students' motivation. In addition, Baliiel, Duran and Bilgili (2011) in their study on the effect of field-trip observation method reported that students taught unit space puzzle in science and technology course showed positive motivation than their lecture group counterparts. Wanjau (2014) confirmed that students taught Kiswahili using mastery learning approach have significant effect on students' motivation than the control group. In this study, the observed significant difference in students level of motivation could be as a result that MLA incorporate each unit taught with formative assessment which provide feedback

to students to determine whether the mastery of unit taught is achieve or not for remediation

From the results in Table 4.7, it showed that there is no significant difference in the academic performance of male and female of students exposed to mastery learning approach. This finding is in agreement with Wambugu and Changeiywo (2008), Agboghrma (2014), Lamidi, Oyelekan and Olorundare (2015). Wambugu and Changeiywo (2008) revealed that gender has no significant difference between the academic performance of male and female students exposed to MLA. The work of Agboghrma (2014) revealed no significant difference between the mean academic performance of male and female students exposed to MLA. The finding is however in disagreement with those of Njoku (2007), Appaw (2011), Achufusi and Mgbemena (2012) and Ordein and Awodun (2013) who reported significant difference between the performance of male and female students. In this study, the reason for this finding could be as a result that MLA provides corrective activities to students that do not achieve mastery of unit taught for remediation which is followed by second formative assessment. The process is continued until mastery of unit taught is achieved

Table 4.8 also revealed no significant difference between the motivation level of male and female students exposed to MLA. The finding is in agreement with Keraro, Wachanga and Orora (2007) and Wanjau (2014). Keraro, Wachanga and Orora (2007) revealed that there is no significant gender difference in motivation towards the learning of Biology among secondary school students exposed to Cooperative Concept Mapping teaching approach. Wanjau (2014) also confirmed that there is no significant difference in the level of motivation between male and female students

taught Kiswahili language using MLA. The finding is however in disagreement with that of Adedeji (2007), Kumar and Sagar (2015) and Yusuf and Mohammed (2017) who reported significant difference in the motivation level between male and female students. In this study, the reason for this finding could be as a result of the suitable methods and materials used to teach the concepts.

CHAPTER FIVE

SUMMARY CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This study investigated the Impact of Mastery Learning Approach on Motivation and Performance in Wave Concepts among Senior Secondary School Physics Students in Zaria, Kaduna State. This chapter focuses on the summary of the research findings, conclusion, limitations of the study and recommendations. The chapter is presented under the following sub-headings:

- Introduction
- Summary
- Major findings
- Conclusion
- Contributions to knowledge
- Limitations of the study
- Suggestion for further studies

5.2 Summary

This study investigated the Impact of Mastery Learning Approach on Motivation and Performance in Wave concepts among Senior Secondary School Physics Students in Zaria, Kaduna State. It also investigated the impact of gender related difference on students' motivation and performance based on Mastery Learning Approach, and is presented in five chapters.

The study was prompted by poor academic performance of students in Nigeria which has been linked to poor teachers' performance in terms of accomplishing the teaching task, which have been attributed to instructional strategy and poor motivation in learning process. The study has four objectives, one of which seeks to determine the impact of mastery learning approach on senior secondary school Physics students' performance. This is guided by four research questions and four null hypotheses respectively. The study was delimited to only SS II students of public secondary schools offering Physics in Zaria Education Zone of Kaduna State. The study also reviewed literature on; Physics as a discipline in science education; teaching of Physics in secondary schools; methods of teaching Physics in secondary schools; methods of teaching science; concept of mastery learning approach; motivation and performance in science education as well as gender and academic performance in science education. The review has some implication to the present study ; it ascertain the impact of MLA on students motivation to enhance academic performance which was lacking in other related studies reviewed based on the literature available to the researcher.

The study adopted pretest posttest control group quasi-experimental research design. Experimental group received treatment using MLA and were as well motivated, while the control group received lecture method only. Out of 304 year II Physics students in the nine coeducational secondary schools in the zone, 67 were randomly sampled from four schools that were pretested to determine their equivalence. Two instruments namely, Physics Performance Test (PPT) and Students Motivation Questionnaire (SMQ) were validated by experts to guide data collection. The four research questions raised were answered using mean and standard deviation while hypotheses testing involve the use of

t-test and Mann-Whitney U-test at 0.05 level of significant. The SPSS statistical package was used for the analysis of data collected. From the results of the findings, it was confirmed that there is significant difference in the academic performance of Physics students exposed to mastery learning approach and those exposed to lecture method only in favour of the experimental group. It was found that there is significant difference in the motivation level of students taught using mastery learning approach and those taught using lecture method only in favour of the experimental group. The result further revealed no significant difference in the academic performance and motivation level of male and female students exposed to MLA. This implies that the approach is gender friendly.

The study concluded that MLA is effective in improving academic performance and motivation of students towards learning Physics. The study contributes to body of knowledge in Physics/science education in the sense that MLA was found effective than lecture method in improving students performance and motivation in Physics. The study recommended among others that Physics teachers should adopt the use of MLA in teaching Physics.

5.3 Major Findings

1. Physics students taught using MLA performed significantly better in their academic performance scores than lecture group counterpart.
2. There is significant difference in the motivation level of the students exposed to MLA and those taught using lecture method only in favour of the experimental group.

3. There is no significant difference in the mean scores of male and female students exposed to MLA.
4. There is no significant difference in the motivation level of male and female students exposed to MLA

5.4 Conclusion

Based on the findings of this study, it is concluded that:

1. Students taught wave concepts using MLA performed better academically than their counterpart in the control group.
2. Students exposed to MLA exhibit higher motivation level than their lecture group counterpart.
3. Both male and female students taught wave concepts using MLA do not differ significantly from one another in academic performance and motivation level.

5.5 Contributions to Knowledge

This study "Impact of Mastery Learning Approach on Motivation and performance in Physics among Secondary School students" has contributes to knowledge in Physics/science education in the following ways:

- It has been established in this study that students taught wave concepts using Mastery Learning Approach had significant impact on academic performance mean scores and increased motivation level of Physics students at secondary school.

- Teachers can now see reasons to adopt MLA for effective teaching and learning, because it allows for students active participation.
- Physics academic performance test was developed for this study and it was found to be effective in improving students' academic performance.
- MLA has been proven to be gender friendly hence, the need to give both male and female equal chance to learn and interact with instructional materials'
- The findings of the study have significant contributions and great implications for Physics teachers

5.6 Recommendations

On the basis of the findings obtained from this study, the following recommendations are made:

1. Physics teachers should adopt and use MLA as it motivate students in teaching learning Physics
2. MLA is gender friendly because it aided teaching among the male and female students, hence, it is recommended for both genders.
3. In-service training programs in form of seminars and workshops organized for Physics teachers by ministries of education and teachers training institutes should also focus on MLA for the teaching and learning of Physics.
4. Both federal and state ministries of education in the country should encourage and monitor the effective use of MLA at secondary school level.
5. Curriculum planners should help in designing MLA and be incorporated in the curriculum in the teaching and learning of Physics at secondary school level.

5.7 Limitations of the Study

This study has the following limitations:

1. The study is restricted to only two secondary schools in Zaria Education Zone of Kaduna State, as such, it limits the scope generalization
2. A sample size of 67 SSII Physics students was used. It may be possible that when larger sample size is used, the result might differ.
3. The conclusion reached about the effectiveness of Mastery Learning Approach in this study is only limited to wave concepts

5.8 Suggestions for Further Studies

This study can further be extended in the following ways:

1. The scope and sample size can be expanded with a view to finding out if similar or different result may be obtained
2. Further studies can be extended into private and federal schools. Comparison should also be made among the federal, state, government and private schools with a view to finding out if similar or different result may be obtained.
3. This study can be extended to students of tertiary institutions such as Colleges of Education, Polytechnics and University to investigate if these levels of education will have similar results on the variables that this study dealt with.
4. This type of study can be replicated in many other states of the federation for wider and more generalized scopes of the findings of such studies.

5. The results obtained in this research are for Physics, a study can be tried in other disciplines such as Mathematics, Biology, and Chemistry among other subjects in secondary school to see what the result would be.

References

Abimbola I. (2001). *Fundamental Principles and Practice of Instruction* Ilorin belodan (Nigeria) enterprises and tuned Babs Printers.

Abiola, O. O. (2007). *Procedures in Educational Research.* Kaduna: Kingo Nigeria Limited.

Achor, E. E. & Orji, A .C. (2009). Level of Students' Motivation in Classroom Interactions in Integrated Science. *Journal of Research in Curriculum and Teaching, 4(1), 294-303.*

Achufusi, N. N. & Mgbemena, C. O. (2012). The Effect of Using Mastery Learning Approach on Academic Achievement of Senior Secondary School II Physics Students. *Elixir International Journal, 51, 10735-10737.*

Adams, C. M. (1996). Gifted Girls and Science: Revisiting the Issue. *Journal of Secondary Gifted Education,* 7(4), 447-459.

Adamu, M. & Ahmad, U. (1999). Use of Selected Methods of Teaching in Enhancing Academic Achievement of Slow Learners in Biology Unpublished B.Sc (Ed) Project, Ahmadu Bello University, Zaria, Nigeria

Adedayo, J.O. (2008). Effect of Electronics Artisans' Background and Competence on Science and Technology Advancement in Nigeria. *Research in Curriculum Studies,* 5(1), 132-136.

Adedeji, T. (2007). The Impact of Motivation on Students' Academic Performance and Learning in Mathematics among Secondary School Students in Nigeria. *Eurasia Journal of Mathematics, Science and Technology Education, 3(2), 149-156.*

Adesoji, F. A. (2008). Students' Ability Levels and Effectiveness of Problem-Solving Instructional Strategy. *Journal of Social Sciences, 17(1), 5-8.*

Adeyemi, B. A. (2003). An Evaluation of Social Studies Curriculum in Osun State Colleges of Education, Nigeria. Unpublished M.A. (Ed). Thesis, Obafemi Awolowo University Ile-Ife.

Adeyemo, S. A. & Babajide, F. T. (2014). Effects of Mastery Learning Approach on Students' Achievement in Physics. *British Journal of Scientific & Engineering Research, 5(2), 910-920.*

Adeyemo, S. A. (2010). Teaching and Learning of Physics in Nigerian Secondary Schools: The Curriculum Transformation, Issues, Problems and Prospects. *Society of Education Journal India, 1(1), 99-111.*

Admu, A. O. (2001). *Teaching and Learning Using Computer Assisted Instructions.* Ilorin Model Press Ltd.

Aduda, D. (2003). Kenya Certificate of Secondary Education, Examination Result Released by Minister of Education. Daily Nation, Nairobi: Nation Media Group Ltd.

Agboghorom, T. E. (2014). Mastery Learning Approach on Secondary School Student, Integrated Science Achievement. *British Journal of Education, 2(7), 80-88.*

Aguele, L. I. & Agwugah, N. V. (2007). Female Participation in Science, Technology, and Mathematics (STM) Education in Nigeria and National Development. *Journal of Social Science, 15 (2), 121-126.*

Ainley, M. (2004).Connecting with Learning: Motivation, Affect and Cognition in Interest Process. *Educational Psychology Review,* 18(4), 391-405.

Ajayi, P.O. (2007). Evaluation of the Implementation of Senior Secondary School Physics Curriculum in South West Nigeria (Unpublished Ph. D thesis). University of Ado-Ekiti, Nigeria.

Ajejalami, D. (1990). *Science and Technology Education in Africa focus on Seven Sub-Saharan Countries. Lagos*: University of Lagos Press, Lagos.

Akanbi, A. O. (2002). Students' Correlates as Function of Performance in the School Certificate Physics in Ilorin, Kwara State. *Kantagora Journal of Science and Technology, 3(2), 67-81*.

Akubuilo, D. U. (2004). The Effects of Problem Solving Instructional Strategy on Students' Achievement and Retention to Location in Enugu State. *Journal of Science Teachers Association of Nigeria STAN, 29(1) 90-99.*

Ali, A. & Akubue, A. (1998). Discovery and Expansion Text. Presentation among Anambra, Benue, Imo, Bendel State of Nigerian Secondary Schools Mathematics. *Journal of Research in Learning and Teaching, 1(1), 78-9*

Ali, E., Ismail, Y., & Sedef, A. (2010). Investigation of Relationships between Attitudes towards Physics Laboratories, Motivation and Amotivation for the Class Engagement. *Eurasian Journal of Physics and. Chemistry Education*, *Jan* (Special Issue), 59-64.

Aluko, K. O. (2004). Effects of Cooperative and Individualistic Instructional Strategy on Students' Problem Solving Ability in Secondary Schools Chemistry in Ilesha, Nigeria. Unpublished Ph.D Thesis, University of Ilorin, Ilorin.

Anderson, J. R. (2000). *Learning and Memory: An Integrated Approach (2nd ed.).* New York:John Wiley and Sons, Inc.

Appaw, E.L. (2001). Comparing Concept Mapping and Traditional Methods in Teaching some Selected Topics in Biology at the Senior high School level in Ghana. Unpublished Master thesis, Department of Science Education, University of Cape Coast, Ghana.

Arigbabu, A. A. & Mji, A. (2004). Is Gender a Factor in Mathematics Performance among Nigerian Pre-service Teachers? *Sex Role, 51(11 &12),* 749- 752.

Ariyo, A. O. (2006). School and Student Factors as Determinants of Students' Achievement in Physics at the Senior Secondary School level in Oyo State, Nigeria. An Unpublished PhD Thesis, University of Ibadan

Arlin, M. & Webster, J. (1983). Time Costs of Mastery Learning. *Journal of Educational Psychology, 75(2), 187-195*.

Aschbacher, P. R., Lee, E. & Roth, E. J. (2010). Is Science me? High School Students' Identities, Participation and Aspirations in Science, Engineering and Medicine. *Journal of Research in Science Teaching, 47, 562-584*

.

Atadoga, M. M. & Lakpini, M. A. (2013). A Comparison of Numeracy Achievement of Primary School Pupils Taught Using Whole Class and Varied Classroom Organization Instructions. Proceedings of Multicultural African Conference, Held At Faculty of Education, Ahmadu Bello University, Zaria Between 11th and 15th June, 2013.

Atadoga, M. M. & Onoalopo, A. O. (2008). *A Hand Book on Science Teaching Method*. Zaria, SHOLA Press.

Atere, P. (2006). Geography Methods, Lagos: National Open University of Nigeria. Retrieved from www.NOU.EDU.NG. on 20/03/2015 by 1:300pm.

Ayot, M. O. & Patel, M. M. (1987). Instructional Methods (General Methods) Series on Provision of Leadership Training in Teacher Education Supported by ODA through British Council HED School. Kenyatta University, Faculty of Education and University of London, Institute of Education.

Badola, S. (2013). Effect of School on Academic Performance, Motivation of Secondary Level Students in Garhwal, *U.K Educational confab, 2(15), 61-66*

.

Baliiel, B., Duran, M. & Bilgili, S. (2011). Effect of Field Trip Observation Method on Motivation of Students. A Paper Presented at 2nd International Conference on New Trends in Education and their Implication. 22-29 Antalaya Turkey.

Bandalos, D.L., Geske, J.A., Finney, S.J. (2005). A Model of Statistic Performance Based on Achievement Goal Theory .*Journal of Educational Psychology*. 95(3), *604-616.*

Bandura, A. (1997). *Self-Efficacy: The Exercise of Control.* New York, NY: W.H. Freeman.

Baum, W. M. (2005). *Understanding Behaviorism*: *Behavior, Culture and Evolution* Malden MA: Blackwell Publishing.

Berry, R., (2008). *Assessment for Learning*. Hong Kong: Hong Kong University Press.

Bichi, S. S. (2002). Effects of Problem- Solving Strategy and Enriched Curriculum on Students' Achievement in Evolution Concepts among Secondary Schools Students. Unpublished PhD thesis, A.B.U. Zaria.

Bilesanmi-Awoderu, J. B. (2006).Effect of Computer-Assisted Instruction and Simulation/Games on the Academic Achievement of Secondary School Students' in Biology. *Sokoto Educational Review, 8(1),* 49-60.

Billings, D. (2000). Women's Ways of Knowing and the Digital Divide. Paper Presented in an Interactive Paper Presentation.

Blanchard, M. R., Southerland, S. A., Osborne, J. W., Sampson, V. D., Annetta, L. A. and Granger, E.M. (2010). Is Inquiry Possible in Light of Accountability? : A Quantitative Comparison of the Relative Effectiveness of Guided Inquiry and Verification Laboratory Instruction. *Science Education, 94(4) 577-616.*

Blank, W. (1997). Authentic instruction: In W.E. Blank & S. Harwell (Eds.), *Promising Practices for Connecting high School to the Real World* (pp. 15-21). Tampa, FL: University of South Florida. (ERIC Document Reproduction Service). *European Journal of Science and Mathematics Education, 2(4), 407-586, 2014*

Block, J. (1971). *Mastery Learning: Theory and Practice*. New York: Holt, Rinehart, & Winston.

Block, J. H. (1976). Mastery Learning: Current State of the Craft. *Educational Leadership, 37, 114-117.*

Bloom, B. S. (1976). *Human Characteristics.* New York: McGraw-Hill.

Bloom, B. S. (1968). Learning for Mastery. *Evaluation Comment, 1(2),* 1-5. Los Angeles Centre for Study of Evaluation Instructional Programmes (UCCLA)

Bloom, B. S. (1984). The 2 Sigma Problem: The Search for Methods of Group Instruction as Effective as one-on-one Tutoring. *Educational Researcher,* 13(6), 4-16.

Brown, S.M. & H.J. Walberg. (1998). "Motivational Effects on Test Scores of Elementary Students", in Macmillan, J.H. & Wergin, J.F. (eds.).*Understanding and Evaluating Educational Research*. New Jersey: Prentice Hall.

Buntting, C., Coll, K. R. & Campbell, A. (2006). Student Views of Concept Mapping Use in Introductory Tertiary Biology Classes. *International Journal of Science and Mathematics Education, 4, 641–668.*

Carroll, J. B. (1963). A Model of School Learning. *Teachers College Record, 64(8), 723-733*

Changeiywo, J. M. (2000). Students Image of Science in Kenya: A Comparison by Gender Difference of Schooling and Regional Disparities. Unpublished PhD thesis, Egarton University, Kenya.

Changeiywo, J. M., Wambugu, P. W., & Wachanga, S.W. (2011). Investigation of Students' Motivation towards Learning Secondary School Physics through Mastery Learning Approach. *International Journal of Science and Mathematics Education 9, 1333-1350.*

Chaunhan, S .S. (1973). *Advanced Educational Psychology.* New Delhi: Vilas Publishers House.

Chemers, M.M., Hu, L, Garcia B.F. (2001). Academic Self-efficacy and first-year College Student Performance and Adjustment. *Journal of Educational Psychology*, 93(1), 55-64.

Chin-Chau, L. (1997). Effect of Goal Structure on Chinese Elementary School Students' Goal Orientation, Achievement, Intrinsic Motivation, and Beliefs about Success/Failure. Texas Technology University Libraries.

Clark, C., Guskey, T. & Benninga, J. (1983). The Effectiveness of Mastery Learning Strategies in Undergraduate Education Courses. *Journal of Educational Research, 76*(4), 210-214.

Croxford, L. (2003). The Early Intervention Programme in Scotland: Impact on the Attainment and Attitudes of Primary 3 Pupils. Edinburgh: Center for Educational Sociology, University of Edinburgh.

Davis, D., & Sorrell, J. (1995).Mastery Learning in Public Schools. *Educational Psychology Interactive* Valdosta, GA: Valdosta State University. Retrieved January 3, 2013 from http://teach.v aldosta.edu/whuitt/files/mastlear.html

DeBacker, T K., & Nelson, R.M. (2000). Motivation to Learn Science: Differences Related to Gender, Class type and Ability. *Journal of Educational Research*, 93(4), 245-254.

Deci, E. L. & Ryan, R. M. (1985). *Intrinsic Motivation and Self Determination in Human Behaviour* New York: Plenum.

Deci, E. L. (1971). Effects of Externally Mediated Rewards on Intrinsic Motivation *Journal of Personality Social Psychology*, 18 105-115

Dembo, M. H. (1994). *Applying Education Psychology (5th ed.)* White Plains, NY: Longman.

Dev, P. C. (1997). Intrinsic Motivation and Academic Achievement: What does their Relationship imply for the Classroom Teacher? *Remedial & Special Education*, *18*(1), 12-19.

Dierks, W. (1981). Teaching The Mole. *European Journal of Science Education, 3, 145-148.*

Din Y. Y., Ming M. C., & Esther S. H. (2004). Hong Kong Students' Achievement in Oecd-pisa Study: Gender Differences in Science Content, Literary Skills, and Test Item Formats. *International Journal of Science and Mathematics Education, 2(1), 91-106.*

Dori, Y. & Hameiri, M. (1998). The 'Mole' Environment Study Ware: Applying Multidimensional Analysis to Quantitative Chemistry Problems. *International Journal of Science Education, 20(3), 317-333.*

Dowson, M. & Mcinerney, D. M. (2001). Psychological Parameters of Students' social and Work Avoidance goals: A Qualitative investigation. *Journal of Educational Psychology 93(1), 35-42*

Drzewiecki, L. A., & Westberg, K. L. (1997). Gender Difference in High School Students Attitudes towards Mathematics in Traditional Versus Cooperative Group. The National Research Centre on the Gifted and Talented. *Spring Newsletter*.

Eccles, J. S., Lord, S. E., Roeser, R. W., Barber, B. L., & Jozefowicz, D. M. (1997). The Association of School Transitions in Early Adolescence with Developmental Trajectories through High School. In Schulenberg J., Maggs., J & Hurrelmann, K. (Eds.), *Health Risks and Developmental Transitions During Adolescence*, 283-320. New York: Cambridge University Press.

Eccles, J., Wigfield, A., & Schiefele, U. (1998). Motivation to Succeed: In W. Damon (Series Ed.) & N. Eisenberg (Vol. Ed.), *Handbook of Child Psychology: Vol. 3. Social, Emotional, and Personality Development* (5th ed., pp. 1017-1095). New York: Wiley.

Effandi, Z. & Zanaton, I. (2007).Promoting Cooperative Learning in Science and Mathematics Education: A Malaysian Perspective. *Eurasia Journal of Mathematics, Science and Technology Education, 3(1),* 35-39.

Erinosho, Y.E. (2005). Women and Science. 36th Inaugural Lecture, Olabisi Onabanjo University, Ago-Iwoye, 1-37. Federal Ministry of Education (1981). Core Curriculum for Integrated Science: Junior Secondary Schools: Nigeria.

Eryilmaz, H (2004). The Effect of Peer Instruction on high School Students' Achievement and Attitudes toward Physics. PhD Thesis of Middle East Technical University

Etkina, E. (2005). Physics Teachers Preparation: Dreams and Reality. *Journal of Physics Teacher Education 3(2), 3-9.*

Fakorede A.D. (1999). An Investigation into Gender Difference and Students Achievement in Secondary School Biology: A Case Study of Oyo State. An Unpublished M.Ed Thesis

Federal Republic of Nigeria (2013). National Policy on Education Revised, Abuja: Federal Ministry of Education.

Feldhusen, J.F. & Hoover, S.M. (1986). A Conception of Giftedness: Intelligence, Self-Concept and Motivation. *Roper Review*, 8, 140-143.

Fischer, H. E., & Horstendahl, M. (1997). Motivation and Learning Physics. *Research and Science Education, 27*(3), *411-424.*

Frazer, B. J., Okebukola, P.A., & Jegede, O.J. (1992). Assessment of the Learning Environment of Nigerian Science Laboratory Classes. *Journal of Science Teachers' Association of Nigeria, 27(2), 76-80.*

Geary, D.C, & Hamson, C. (2007). "*Improving the Mathematics and Science Achievement of American Children: Psychology's Role*."RetrievedApril16, 2007, from http/www.apa.org/ed /geary.html.

Gonzuk, S. & Chargok, H. (2001). Gender Differences in Science: Parallels in Interest, Experience, and Performance, *International Journal of Science Education 9, 467-481*

Graham, J. M. (2006). Congeneric and Essentially Tau-equivalent Estimates of Score Reliability: What they are and How to Use them. *Educational and Psychological Measurement, 66, 930–944.*

Guskey, T. R. & Gates, S. L. (1986). Synthesis of Research on the Effects of Mastery Learning in Elementary and Secondary Classrooms. *Educational Leadership, 43(8),* 73-80.

Guskey, T. R. (2007). Closing Achievement Gaps: Revisiting Benjamin S. Bloom's "Learning for Mastery." *Journal of Advanced Academics, 19*(1), 8-31.

Guskuey, T. R. (1986). Staff Development and the Process Teacher Change. *Educational Researcher, 15(5), 5-12.*

Hassard, J.(2005). *The Art of Teaching Science Inquiry and Innovation in Middle and High School.* Oxford University Press. Pp 54-86.

Hohn, R. L. (1995). *Classroom Learning and Teaching*. New York: Longman.

Honcock, D. (2004). Cooperative Learning and Peer Orientation Effects on Motivation and Achievement. *Journal of Educational Research, 97(3), 159-166.*

IAEP, (1992). *International Assessment of Educational Progress*.

Ike, P. C. (2012). An Analysis of the Impact of Fadama III Project on Poverty Alleviation in Delta State. Nigeria. *Asian Journal of Agricultural Sciences, 4(2), 158-164:* ISBN2041-3890

Isolo, M. O. (2010). Effects of Standardized and Improvised Instructional Materials on Students' Academic Achievement in Secondary School Physics. M.Ed. Thesis, University of Ibadan, Ibadan.

Jacksons, S. (2012). 3 New Teaching Methods Improve the Educational Process. Retrieved from www.gettingsmart.com/2012/09/03- new-teaching-methods-improve-educational-process/on4/2/2015 by 12:00pm

Joe, R. (2011). Don't Lecture Me: Rethinking How College Students Learn. *Hanford American Public Media "American Radio Works"*

Johnson, D. W. & Johnson, F. P. (2000). *Joining Together: Group Theory and Group Skills* (7th edn), Boston, MA: Allyn & Bacon.

Joshi, S.R. (2008). *Teaching of Science.* New Delhi: A.P.H Publishers Corporation. Pp 34-67.

Josiah, M. M. (2012). School Location Versus Academic Achievement in Physics: does Computer-Assisted Instruction (CAI) has any Effect? *Journal of Educational and Social Research, 2(8), 162-168.*

Kennedy, H. L. (2000). Society Cannot Continue to Exclude Women from the Field of Science and Mathematics. *Mark Education 120(3), 529.*

Keraro, F. N., Wachanga, S. W. & Oraro, W. (2006). Effects of Cooperative Concept Mapping Teaching Approach on Secondary School Students' Motivation in Biology in Gucha District. *Kenya International Journal of Science and Mathematics Education, 5, 111-124*

Kibler, R. J., Cegala, D. J., Watson, K. W., Barkel L. L. & David, T. M. (1981). *Objectives for Instruction and Evaluation*. Allyn and Bacon Inc. Toronto, U.S.A.

Kiboss, J. K. (2002). Impact of a Computer-Based Physics Instruction Program on Pupils Understanding of Measurement Concepts and Methods Associated with School Science. *Journal of Science Education and Technology, 11(2), 193-198.*

Kohn, A. (1993). Punished by Rewards: *The Trouble with Gold Stars, Incentive Plans, A's, Praise, and other Bribes*. Boston, MA: Houghton Mifflin.

Kolawole, E. B. (2007). Effects of Competitive and Cooperative Learning Strategies on Academic Performance of Nigerian Students in Mathematics. *Educational Research Review, 3(1), 33-37*

.

Kulik, C., Kulik, J., & Bangert-Drown, R. (1990). Effectiveness of Mastery Learning Programmes: A Meta-analysis. *Educational Research Review, 60(2), 265-306.*

Kumar, S. & Sagar, S. (2015). Academic Achievement of Socially Disadvantaged Secondary School Students in Relation to Achievement Motivation. *International Interdisciplinary Research Journal. 4(5), 2249-9598*

Kushman, J. W., Sieber, C. & Harold, K. P. (2000). This isn't the Place for me: School Dropout. In D. Capuzzi & D. R. Gross (eds). Youth at Risk: A Prevention Resource 48 for Counselors, Teacher and parents (3rd ed. PP 471-507). Alexandaria, VA: American Counseling Association

Lamidi, B. T., Oyelekan, O.S. & Olorundare, A. S. (2015). Effects of Mastery Learning Instructional Strategy on Senior School Students' Achievement in the Mole Concept. *Electronic. Journal of Science Education, 19(5), 1-20.*

Larson, J. O. (1997). Constructing Understandings of the Mole Concept: Interactions of Chemistry Text, Teacher and Learners. Paper presented at the Annual Meeting of the National Association for Research in Science Teaching (70th, Oak Brook, IL, March 21-24, 1997).

Lawal, F. K. (2009). Effectiveness of a Conceptual Change Instructional Strategy in Remediating Identified Misconceptions in Genetics among Senior Secondary School Students in Kano State. Unpublished PhD thesis, Ahmadu Bello University, Zaria, Nigeria.

Lee, V. S. (2004) *Teaching and Learning through Inquiry*. Sterling, V.A: Stylus Publishing.

Levi, L. (2000). Gender Equity in Mathematics Education. *Teaching Children Mathematics, 7(2), 101-105.*

Linn, M. C. (1992). Science Education Reform: Building the Research Based. *Journal of Research in Science Teaching, 5(4), 321-330.*

Logan, M. (2008). Engaging Students in Science Across the Primary Secondary Interface: Listening to the Students' voice. *Research in Science Education, 38(4), 501-527.*

Lohrman, A.N (2013).Teachers Perceptions of Science Content Knowledge and Retention among Eighth Grade Students. Masters thesis. Faculty of Education, Ohio University, USA.

Malik, A. A. & Jamil, A. (2012). Effect of Motivation and Parental Influence on the Educational Attainment of Students at Secondary School Level. *International Journal of Academic Research, 2 (15), 61-66.*

Mills, H.R. (1991). *Teaching and Training: A Handbook for Instructors (3rd ed*). London: Macmillan Publishers

Mitee, T. L. & Obaitan, G. N. (2015). Effect of Mastery Learning on Senior Secondary School Students' Cognitive Learning Outcomes in Quantitative Chemistry. *Journal of Education and Practice, 6(5), 34-38.*

Mkpanang, J. T. (2000). Personality Profile of Teachers and their Students' Performance in Post-Basic Modern Physics. *African Research Review, 9(1), 159-168.*

Morrison, H.C. (1926). *The Teaching in Secondary School*. Chicago: The University of Chicago Press.

Muhammad, B. (2016). Impact of Multimedia-Enriched Lecture Method on Retention and Performance in Physics among Secondary School Students in Kano State, Nigeria. An Unpublished Master thesis. Department of Science Education, Ahmadu Bello University Zaria Nigeria.

Mugenda, O., & Mugenda, A. (2003).Research Methods.*Quantitative & Qualitative Approaches*. Nairobi, Kenya: ACTS press.

Muurenzi, R. (2009). Rwanda ICT Policy Frame Work. Paper Presented at the Development of an Equitable Information Society: the Role of African Parliament's Conference.

Ndirangu, M. (2000). A Study on the Perspective of Teaching Practice Project on the Teaching of Science in Selected Secondary Schools in Kenya. Unpublished PhD thesis, Egerton, University, Njoro.

Njoku, Z. C. (2007). Engendering Learning Equity in Science and Technology Classrooms for Sustainable Development. Proceedings of the 50th Anniversary Conference of Science Teachers Association of Nigeria. *Heinemann Educational Books* (Nig) Plc. 24-31

Nolen, S.B. (2003). "Learning Environment, Motivation, and Achievement in High School Science." *Journal of Research in Science Teaching*, 40(4): 347-368.

Nwagbo, C. (2006). Effects of Two Teaching Methods on the Achievement and Attitude to Biology Students of Different Levels of Scientific Literacy. *International Journal of Educational Research (2006), 216-229.*

Obeka, S. S. (2011). *Panacea of Science Education Research.* Ahmadu Bello University Press, A.B. U. Zaria

Ogbonna, B.B.O. (2000). Remembering and Transferring of Learning. In Ogbonna, B.B.O., Ogbulafor, S.O., Lubis D., Mangvwat, S.E., Torkan, J.J and Buhari, Y (eds). *New Perspective in Education* Jos: Wais printing press. Pp 52-60

Ogunkola , J. B. & Bilesanmi- Awoderu J. B. (2000). Effect of Laboratory and Lecture Methods on Students Achievement in Biology. *African Journal of Education 5(2), 247-260.*

Ogunleye, G. O. (2002). Documentation and Record Keeping in Secondary Schools Science Laboratories; the Case of Ado-Ekiti. In: Topical Issues in Research and Education. Ado-Ekiti, Akinlua.

Okwilagwe, E. A. (2003). Quality Assurance of Teaching and Learning Process of the UBE Primary Education through Effective Monitoring and Education. *Nigerian Journal of Educational Research and Evaluation, 4(1), 79-86*

Oladejo, M. A. (2011). Instructional Materials and Students' Academic Performance in Physics: Some Policy Implications. *European Journal of Humanities and Social Science, 2(1), 112-127.*

Olaitan, S.O. & Agusiobo (1982). *Principles of Practice Teaching:* Ibadan, spectrum books limited.

Olajide, J. O. & James, T. (2009). Role of Inquiry Teaching in Promoting Entrepreneurships. *International Journal of Education and Science, 3(2), 74-78.*

Olarinoye, R. D. (2000). Strategies for Effective Teaching of Modern Physics: A Keynote Paper Delivered at the STAN Physics Panel Workshop held at Katsina, 24-54 April, 2000

Olatoye, R. A., Aderogba A. A. & Aanu, E. M. (2011). Effect of Co-operative and Individualized Teaching Methods on Senior Secondary School Students' Achievement in Organic Chemistry. *The Pacific Journal of Science and Technology, 12(2),* 311-319. Retrieved January 2, 2012 from http://www.akamaiuniversity.us/PJST.htm

Olorukooba, S. B. (1981). A Survey of the Different Methods of Teaching Science in Zaria and its Environs. Unpublished M.Ed thesis ABU, Zaria.

Olorukooba, S. B. (2001). The Relative Effects of Cooperative Instructional Strategy and Traditional Methods on the Performance of Senior Secondary School Chemistry Studies. Unpublished PhD Dissertation A.B.U, Zaria.

Olubunmi A, (2001). The Impact of School Location and Gender Difference on Students' Achievement in Agricultural Science: A Case Study of Ogun State.

Olumuyiwa, A. & Okunola, O. (1992). *Comprehensive Certificate Physics* Ibadan: University Press Plc.

Oluwatosin, O. B. & Bello, T. O. (2015). Comparative Effect of Mastery Learning and Mind Mapping Approaches in Improving Secondary School Students' Learning Outcomes in Physics. *Science Journal of Education, 3(4), 78-84.*

Omebe, C.A. & Akani, O. (2015). Effect of Instructional Resources on Students Achievement in Physics and Chemistry in Secondary Schools in Ebonyi State. *European Journal Training and Development Studies. 2(2) 56-65*

Onyeizugbo, E. U. (2003). Effects of Gender, Age, and Education on Assertiveness in Nigerian Sample. *Psychology of Women Quarterly, 27, 1-16.*

Ormrod, J. E. (2000). *Educational Psychology (3rd ed.).* Upper Saddle River, NJ: Merrill/Prentice Hall.

Owolabi, T. ((2004). A Diagnosis of Students Difficulties in Physics. *Education Perspectives* 7, 15-20.

Oyoo, S. O. (2009). An Exploratory Study of Kenya Physics Teacher's Approach and Use of Language during Teaching. *Electronic Journal of Literacy through Science, 8, 25-26.*

Petri H. L. (1986). *Motivation Theory and Research,* 2nd edition. USA: Wadsworth Publication.

Philips, O. (2002). *STAN Physics for Senior Secondary Schools* Heinemann Education Book Publishers, Nigeria

Pintrich, P. R., and Maehr, M. L. (Eds.). (2004). *Advances in Motivation and Achievement: Motivating Students, Improving Schools* (Vol. 13). Oxford, England: JAI, An Imprint of Elsevier Science.

Reeve, J. (1996). *Motivating Others. Nurturing Inner Motivational Resources*. Needham Heights: MA: Allyn & Bacon.

Ross C. M. (1999). *The Relationship among Academic Achievement Motivation, Motivation Orientation, and Ability-Achievement Differences in Reading.* Unpublished PhD. thesis University of Alabama, USA.

Ryan, R. M. & Deci, E. L. (2000). Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions. *Contemporary Educational Psychology, 25, 54-67.*

Ryan, R.M, and Deci, E L. (2000). Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions. *Contemporary Educational Psychology*, 54-67.

Sambo, A. A. (2008). *Research Methods in Education* Lagos: Stirling-Horden Publishers Nig. Ltd

Samuel, O. S. (2007). Effects of Personalized System of Instruction on Students` Academic Achievement in Chemistry. *Pakistan Journal of Social Sciences, 4*, 132-136. Retrieved October 5, 2012 from http://medwelljournals.com/abstract/?doi=pjssci.2007.132.136

Senko, C. & Harackiewicz, J.M. (2005). Regulation of Achievement Goals: the Role of Competence Feedback. *Journal of Educational Psychology*, 97(3), 320-336.

Sever, S. (1997). *Turkish Teaching and Mastery Learning* Ankara: Ani Yayincilik.

Sharma, A. (2012). Brief note on Observation Method in Teaching Geography. Retrieved from www.preservearticles.com/201/02254214/brief-note-0nobservation-method-in-teachinggeography.html. on 6/2/2015 by 1:45pm.

Sharma, P. (2013). Role of Interactive Multimedia for Enhancing Students Performance and Retention. Department of basic Education , uttar Pradesh, india.

Shihusa, H. & Keraro, F. N. (2009). Using Advance Organizers to Enhance Students' Motivation in Learning Biology. *Eurasia Journal of Mathematics, Science & Technology Education, 5940, 413-420.*

Shittu, S. (2012). Effects of Guided Inquiry Strategy on the Academic Performance and Attitude of Low Achievers in Physics among Senior Secondary School II Students of Kaduna Metropolis. Unpublished Master Thesis, Department of Science Education, Ahamdu Bello University Zaria, Nigeria

.

Singh, K., Granville, M., and Dika, S. (2002). Mathematics and Science Achievement: Effects of Motivation, Interest and Academic Engagements. *The Journal of Educational Research, 95*(6), 323-332.

Skinner, B. F. (1984). The Evolution of Behavior. *Journal of Experimental Analysis of Behavior, 41,* 217-221.

Talib, O., Wong, S.L., Azhar, S.C., & Abdullah, N. (2009).Uncovering Malaysian Students' Motivation to Learning Science. *European Journal of Social Sciences*, 8(2), 266-276.

Tuckman, B.W. (1975). *Measuring Education Outcomes*. Harcout Brace: New york Horawick.

Umar, A.A. (2011). Effects of Biology Practical Activities on Students' Process Skill Acquisition in Minna, Niger State, Nigeria. *Journal of Science, Technology and Mathematics Education, 7(2), 118-126.*

Umar, S. (2006). An Investigation into Barrier Militating against Effective Management of Classroom Pedagogy of Geography Curriculum in Militating Schools in Nigeria. Unpublished Master's thesis, University of Jos, Nigeria.

Usman, I.A. (2010). Effect of Indoor and Outdoor Laboratory Instructional Methods on Academic Achievement of Junior Secondary School, Integrated Science Students in Zaria. *Journal of Studies in Science and Mathematics Education,* 1(1), 66-73.

W.A.E.C. (2013). *Chief Examiner's Report Nigeria. 49-174*

Wachanga, S. W. (2002). Relative Effects of Cooperative Class Experiment Teaching Method on Secondary School Students' Motivation to Learn Chemistry in Nakuru District, Kenya. *Zimbabwe Journal of Educational Research, 14(3), 229–253.*

Walberg, H. J. (1988). Creativity as Learning. In R. J. Sternberg (Ed.): *The Nature of Creativity*. New York: Cambridge University Press. pp. 340-361

Wambugu, P. W. & Changeiywo, J. M. (2008).Effects of Mastery Learning Approach on Secondary School Students' Physics Achievement. *Eurasia Journal of Mathematics, Science & Technology Education, 4(3),* 293-302.

Washburne, C. W. (1922). Educational Measurement as a Key to Individualizing Instruction and Promotions. *Journal of Educational Research, 5, 195-206.*

Wigfield, A., Harold, R.D., Freedman-Doan, C., Eccles, J.S., Yoon, K.S., Arbreton, A.J.A.,& Blumenfeld, P.C. (1997). Change in Children's Competence Beliefs and Subjective Task Values across the Elementary School Years: A 3-year Study. *Journal of Educational Psychology* 88(3), 451-469.

Wilson, C. (2004). *Intervention Central-Prior Knowledge: Activating the 'Known'*. RetrievedDecember5,2012fromhttp://www.interventioncentral.org/htmdocs/interventions/rdngcompr/priork nows.html

Wong, T. A. (2006). Singapore Students' and Teachers' Perceptions of Computer-Supported Project Work Classroom Learning Environments. *Journal of Research on Technology in Education, 3(1), 231-247.*

Yang, D. H. (2010). Gender and Classroom Learning. *Psychology in the Schools, 22, 08–223.*

Zohar, D. (1998). An Additive Model of Test Anxiety: Role of Exam Specific Expectations. *Journal of Educational Psychology.90, 330-340.*

APPENDIX I

PHYSICS PERFORMANCE TEST (PPT)

SECTION A: Bio-data

Name of School: …….

Class: ……...

Gender: Male [ ] Female [ ]

SECTION B: Instructions

1. Write the name of your school and tick the gender in the space provided.
2. Read each question carefully.
3. Shade the correct option on your answer sheet.

ATTEMPT ALL QUESTIONS

1. A disturbance which travels through a medium transferring energy from one point to another without causing any permanent displacement of the medium is called……..
   (a) Motion
   (b) Acceleration
   (c) Momentum
   (d) Wave
2. The process involved in the transferring of disturbance which travels through a medium transferring energy from one point to another without any transfer of particles of the medium is termed as…….
   (a) Wave change
   (b) Wave frequency
   (c) Wave motion
   (d) Wave length

3. All waves have their sources as ……..

   (a) Vibration

   (b) Solid

   (c) Gas

   (d) Liquid

4. In wave motion, what kind of energy is applied?

   (a) Potential

   (b) Mechanical

   (c) Kinetic

   (d) Sound

5. All the following are types of waves in physics EXCEPT……

   (a) Mechanical

   (b) Electromagnetic

   (c) Sun

   (d) Transverse

6. A wave that requires a material medium for their propagation is…..

   (a) Mechanical

   (b) Electromagnetic

   (c) Solar

   (d) Transverse

7. A type of wave that does not required a material medium for their propagation is…..

   (a) Mechanical

(b) Electromagnetic

(c) Sun

(d) Transverse

8. Which of the following is an example of electromagnetic wave?

(a) Radio waves

(b) Sound waves

(c) Water waves

(d) String waves

9. X-rays and gamma rays are examples of…….

(a) Electromagnetic waves

(b) Mechanical waves

(c) Solar waves

(d) Transverse waves

10. Wave consists of …… that moves without carrying

(a) Oscillations

(b) Mechanisms

(c) Solidification

(d) Vectors

11. An instrument in the laboratory where water waves can be produced and studied is called……..

(a) Wave tank

(b) Water tank

(c) Ripple tank

(d) Solar tank

12. When the dipper of the ripple tank is in the form of horizontal metal or wooden strip,……waves are formed.

    (a) Parallel plane

    (b) Vertical plane

    (c) Spherical plane

    (d) Circular plane

13. Circular waves are produced when the dipper is in the form of.……

    (a) Horizontal metal

    (b) Wooden strip

    (c) Sphere

    (d) Transverse

14. A wave which travels in a direction parallel to the vibration of the medium is called……

    (a) Transverse wave

    (b) Longitudinal wave

    (c) Horizontal wave

    (d) Vertical wave

15. The time taken by a wave particle to make one complete oscillation is called…….

16. The number of complete vibrations or cycles that a particle makes in one second is called……

17. The distance between two successive troughs is called……

18. The maximum displacement of a particle from its rest position is called……

19. In the application of wave, diffraction is the ability of wave to……

    (a) Stick around path in the obstacle

    (b) To bend around path in their obstacle

    (c) To bend around obstacle in their path

    (d) To move around obstacle outside their path

20. Which of the following is not a property of wave?

    (a) gravity

    (b) Diffraction

    (c) Interference

    (d) Reflection

21. An angle which the direction of motion of a plane makes with the normal to the metal surface is known as angle of…….

    (a) Reflector

    (b) Incidence

    (c) Reflection

    (d) Convex

22. The frequency of a vibrating source is 450Hz and the velocity of the sound it produces in air is $330ms^{-1}$ .Find how far the sound travels when the source completes 50 vibrations.

    (a) 26.67km

    (b) 67.26km

    (c) 36.67km

    (d) 58.86km

23. A radio station broadcasts at frequency of 300KHz. If the speed of the wave is $3x10^5ms^{-1}$, calculate the wave length of the wave.

    (a) 5km (c) 1km

    (b) 2km (d) 11km

24. A plane progressive wave is represented by the equation y=sin $(200\pi r - 0.5x)$. what is the frequency of the wave?

    (a) 100Hz

    (b) 1100Hz

    (c) 1000Hz

    (d) 1010Hz

25. The law of reflection states that, the angle of…….is equal to the angle of……

26. A node is a point on a stationary wave where there is……. of the medium.

    (a) Movement

    (b) Speed

    (c) Slow

    (d) No movement

27. Constructive interference occurs in the region where……. From the two waves overlap.

    (a) Diffractions

    (b) Trough

    (c) Interference

    (d) Constructors

28. …….is the effect produced when two waves of the same frequency, amplitude and wavelength travelling in the same direction in a medium are superposed as they simultaneously pass through a given point.

    (a) Interference

    (b) Reflection

    (c) Interjection

    (d) Reference

29. One of the best examples of sound waves is……..

    (a) Water

    (b) Radio

    (c) Light

    (d) Polarization

30. Which of the following best describe the relationship between frequency, wavelength and velocity of a wave?

    (a) v= $v\lambda$

    (b) v= $f\lambda$

    (c) g= $f\lambda$

    (d) $a = f\lambda$

31. The relation Y=Asin$\frac{2\pi x}{\lambda}$ mathematically represents……..

    (a) Wave length

    (b) Wave equation

    (c) Reflection equation

    (d) Deflection equation

32. A plane progressive wave is represented by the equation y=2sin($1000\pi r - 0.5x$) where the symbols have their usual meanings. What is the frequency of the wave?
    (a) 500Hz
    (b) 100Hz
    (c) 800Hz
    (d) 1000Hz
33. Which of the following is not a mechanical wave?
    (a) Wave propagated in stretched string
    (b) Radio waves
    (c) Sound waves
    (d) Water waves
34. A line or surface in the path of an advancing wave on which all the particles are vibrating in step or in phase is……..
    (a) Wave length
    (b) Wave front
    (c) Wave tank
    (d) Wave side
35. A sudden increase in magnitude of a physical quantity, shortly followed by a rapid decrease is known as……
    (a) Pulse
    (b) Wave
    (c) String
    (d) Rigid

36. A wave is said to be plane-polarized if its vibrations occur only in…….

(a) Two plane

(b) One plane

(c) Three plane

(d) Four plain

37. The distance between a node and an antinode for a transverse wave is……

(a) $\frac{\lambda}{2}$

(b) λ

(c) $\frac{\lambda}{3}$

(d) $\frac{2}{\lambda}$

38. The two forms of interference are……..

(a) Constructive and gravity

(b) Constructive and destructive

(c) Destructive and mechanical

(d) Constructive and stationary

39. The Polaroid is used in sun glasses to…….

(a) Increase the intensity of incident light

(b) Reduce the intensity of light

(c) Cause accident

(d) Cause vibration of molecule

40. …….can affects transportation in the day time.

(a) Wave acid (c) Wave due

(b) Wave reflection (d) Wave freezing

APPENDIX II

MARKING SCHEME FOR PHYSICS PERFORMANCE TEST (PPT)

1	D	11	C	21	B	31	B
2	C	12	A	22	C	32	A
3	A	13	A	23	A	33	B
4	C	14	B	24	C	34	B
5	C	15	Period	25	Incidence, reflection	35	A
6	A	16	Frequency	26	C	36	B
7	B	17	Wavelength	27	B	37	A
8	A	18	Amplitude	28	A	38	B
9	B	19	C	29	B	39	B
10	A	20	A	30	B	40	B

APPENDIX III

ANSWER SHEET FOR PHYSICS ACADEMIC PERFORMANCE TEST (PAPT)

SECTION A: Bio-data

School: …….

Class:…….

Gender Male [ ] Female [ ]

SECTION B: Instruction

Please shade the correct option appropriately.

1	=A=	=B=	=C=	=D=	21	=A=	=B=	=C=	=D=
2	=A=	=B=	=C=	=D=	22	=A=	=B=	=C=	=D=
3	=A=	=B=	=C=	=D=	23	=A=	=B=	=C=	=D=
4	=A=	=B=	=C=	=D=	24	=A=	=B=	=C=	=D=
5	=A=	=B=	=C=	=D=	25	_____			
6	=A=	=B=	=C=	=D=	26	=A=	=B=	=C=	=D=
7	=A=	=B=	=C=	=D=	27	=A=	=B=	=C=	=D=
8	=A=	=B=	=C=	=D=	28	=A=	=B=	=C=	=D=
9	=A=	=B=	=C=	=D=	29	=A=	=B=	=C=	=D=
10	=A=	=B=	=C=	=D=	30	=A=	=B=	=C=	=D=
11	=A=	=B=	=C=	=D=	31	=A=	=B=	=C=	=D=
12	=A=	=B=	=C=	=D=	32	=A=	=B=	=C=	=D=
13	=A=	=B=	=C=	=D=	33	=A=	=B=	=C=	=D=
14	=A=	=B=	=C=	=D=	34	=A=	=B=	=C=	=D=
15	_____				35	=A=	=B=	=C=	=D=
16	_____				36	=A=	=B=	=C=	=D=
17	_____				37	=A=	=B=	=C=	=D=
18	_____				38	=A=	=B=	=C=	=D=
19	=A=	=B=	=C=	=D=	39	=A=	=B=	=C=	=D=
20	=A=	=B=	=C=	=D=	40	=A=	=B=	=C=	=D=

APPENDIX IV

STUDENT MOTIVATION QUESTIONNAIRE (SMQ)

Dear Respondent,

The bearer of this research instrument is a Master student in the Department of Science Education, Faculty of Education, Ahmadu Bello University Zaria. The items presented are designed to determine the degree of your motivation in Senior Secondary School II Physics using mastery learning approach. You are therefore requested to rate yourself on the questionnaire items. You are guaranteed an outmost confidentiality as the information provided will be used strictly for this research only.

Yours faithfully,

Mustapha Sani Bichi

P14EDSC8012

SECTION A: BIODATA

GENDER: MALE [ ] FEMALE [ ]

SECTION B:
Instruction: Please tick (√) the appropriate column that suits your interest.

Please take note of the following keys

KEYS: **SD**-Strongly Disagree, **D**- Disagree, **U**-Undecided, **A**-Agree, **SA**-Strongly Agree

Learning Physics Using Mastery Learning Approach has:

S/NO	ITEMS	SD	D	U	A	SA
1	Made me love Physics					
2	Made learning Physics frustrating					
3	Been dull and boring					
4	Made Physics enjoyable					
5	Highly motivated me to work hard in Physics					
6	Helped me to discover skills in Physics					

After Learning Physics Using Mastery Learning Approach:

7	I find it hard to work independently					
8	I expect to rarely be able to apply Physics in life situations					
9	I do not expect to be successful in Physics tasks given by physics teachers in the classrooms					
10	I am now acquiring further knowledge of Physics					
11	I can now study and solve problems in Physics on my own					
12	I expect to perform well in other science subjects					

13	I am able to work independently in physics exercises in and outside Physics classrooms					
14	I expect to score highly in Physics tests					
15	I expect to be able to apply Physics easily in other situations in life					
16	I find learning physics is in itself rewarding					
17	I am now satisfied with the way I learn physics					
18	I no longer feel uneasy during Physics lessons					
19	I am dissatisfied with my participation in classroom Physics activities					
20	I was satisfied with the way Physics was taught in the classroom					
21	I am now satisfied with my performance in Physics assignments and tests					
22	I now aspire to study physics after WAEC					
23	I am not sure whether I have the desire to continue studying Physics					
24	I now find activities in physics lessons meaningful					
25	I discover that Physics subject matter is related to my daily experiences					

26	I realise that Physics gives opportunities for choice, responsibility and inter-personal influence					
27	Physics lessons give me opportunities for cooperation and social interaction					
28	I would like a career that does not require Physics					

APPENDIX V

LESSON PLAN FOR EXPERIMENTAL GROUP (MASTERY LEARNING)

WEEK ONE

Subject: Physics

Topic: waves

Group: Experimental

Class: SSII

Average age: 16 years

Sex: Co-education (mixed)

Teaching Method: Inquiry method

Duration: 120min

Instructional Material: Text books, ribbon, water, container or bucket, rope, string

Objectives: By the end of this lesson the students should be able to:

i. Define the terms wave and wave motion

ii. Give some examples of waves

Prior Knowledge: The students are aware that when one throws a stone into a pond, standing water or water in a larger vessel, the water seems to be moving in a circular form.

Introduction: The teacher starts the lesson by asking the students questions based on things or experience they are familiar with like: what do you observe when a stone is been thrown inside a po nd or water inside a large container? What happen when you touch a part of an empty drum that is been hit or beating by someone? Appropriate or correct responds are rewarded by the teacher with words like: correct answer, keep it up, that is a good responds, clap for him etc while wrong response will receive comments like: that is a good attempt, you can do better. From the students response, the teacher now introduce to the students that the topic for today lesson is Wave.

Presentation:

Teacher's Activities	Students' Activities
The teacher divides the st udents in to three groups A, B and C and provides to each group the following: a large container filled with water, a stone, rope or string, ribbon, nail.	**Step 1:** The teacher ask the students to pick the stone and drop it inside the container with water or take them to the nearby school pond and instruct them to drop the stone inside the pond, then record or take note of what they observe. **Step 2:** The teacher ask the students to tie one end of the rope to a nail in a wall and hold the other end of the tight rope. Tie some ribbons all along the rope. Move the end of the rope in their hand up and down rapidly. **Step 3:** The teacher asks the students what they observe in step 1 and step 2. Their responds will be provided with motivation. **Step 4:** From the students responds, the teacher defines Wave, and wave motion. **Step 5:** The teacher gives examples of wave.

Formative assessment A: The teacher assesses the students to find out whether the unit taught has been mastered or not by administering the following questions:

i. Define wave
ii. What is wave motion
iii. Give two examples of wave

Enrichment activities: The teacher engages the students that attain mastery of unit taught by administering them the following question:

i. A stone is dropped into the centre of a container causes water ripples (waves) to spread outwards, but a cork floating on the water does not travel outwards with the waves. It simply bobs up and down. Explain the observations.

Corrective activities: The teacher assists the students that have not achieved mastery of unit taught to re-teach the unit. They may identify alternative learning resources such as different textbooks, alternative materials or they may simply suggest sources of additional practice.

Formative assessment B: The teacher re-assesses the students that receive remediation to find out whether the unit has been mastered.

LESSON PLAN FOR EXPERIMENTAL GROUP (MASTERY LEARNING)

WEEK TWO

Subject: Physics

Topic: Types of wave

Group: Experimental

Class: SSII

Age: 15-16 years

Sex: Co-education (Mixed)

Teaching Method: Discussion method

Duration: 120min

Instructional Material: Text books

Objectives: After carefully listening to this lesson, the students should be able to:

i. State the types of waves

ii. Explain each types of wave

iii. State examples of each type

Prior Knowledge: The students were taught about wave which leads to the current lesson.

Introduction: The teacher begins the lesson by asking students some questions based on their previous knowledge. Example

What is wave? What is wave motion? Give some examples of wave. Each response is rewarded by the teacher. The teacher now introduces the topic for today lesson will be types of waves.

Presentation:

Teacher's Activities	**Students' Activities**
The teacher shares the class into Four groups A, B, C and D. He share the topics to the group as follows: Group A: Transverse waves	**Step 1:** The teacher share the textbooks to the groups and assign a topic to each of the groups with a group leader. **Step 2:** The teacher asks the students to

Group B: Longitudinal waves Group C: Electromagnetic waves Group D: Mechanical Wave	discuss or interact on the topic assign to their group with the group leaders leading the groups for 40min **Step 3:** The teacher asks the students starting from group A to group D on what they learn while interacting with one another during the group discussion. Students' responses are rewarded. **Step 5:** The teacher asks the students to share their experience and challenges they faced with one another while interacting.

Formative assessment A: The teacher assesses the students to find out whether the unit taught has been mastered or not by administering the following questions:

i. State 4 types of waves
ii. Explain one type of waves mentioned above
iii. Give one example each of mechanical, electromagnetic, transverse and longitudinal waves

Enrichment activities: The teacher engages the students that attain mastery of unit taught by administering the following questions:

You are provided with a coiled metal spring, the coils being of constant diameter. Describe how you will use it to demonstrate:

i. Transverse waves, and
ii. Longitudinal waves.

Corrective activities: The teacher assists the students that have not attain mastery of unit taught to re-teach the unit. They may identify alternative learning resources such as

different textbooks, alternative materials or they may simply suggest sources of additional practice.

Formative assessment B: The teacher re-assesses the students that receive remediation to find out whether the unit has been mastered.

LESSON PLAN FOR EXPERIMENTAL GROUP (MASTERY LEARNING)

WEEK THREE

Subject: Physics
Topic: Terms associated with waves
Group: Experimental
Class: SSII
Age: 16 years
Sex: Co-education (Mixed)
Teaching Method: Discussion Method
Duration: 120min
Instructional Material: Text books
Objectives: By the end of this lesson, the student should be able to:

i. Explain terminologies associated with wave concept:

(a) Cycle

(b) Frequency

(c) Wave length

(d) Period

Previous Knowledge: The learners were taught about types of wave which leads to the present lesson.

Introduction: The teacher introduces the lesson by asking students some questions based on their previous knowledge.

Example:

What are the types of waves?

What are the examples of longitudinal waves?

Each response should be motivated or rewarded

The teacher now writes the topic for today's lesson is Terms associate with wave.

Presentation:

Teacher's Activities	**Students' Activities**
The teacher shares the class into Five groups A, B, C, D and E. He share the	**Step 1:** The teacher share the textbooks to the groups and assign a topic to each of the

topics to the group as follows: A: what is Amplitude? B: what is frequency? C: what is wave length? D: what is period? E: Show the relationships that exist between frequency, velocity and wave length.	groups with a group leader. **Step 2:** The teacher asks the students to discuss or interact on the topic assign to their group with the group leaders leading the groups. **Step 3:** The teacher asks the students starting from group A to group E on what they learn while interacting with one another during the group discussion. Students' responses are rewarded. **Step 4:** The teacher make input on students' response. **Step 5:** The teacher asks the students to share their experience during discussion.

Formative assessment A: The teacher assesses the students to find out whether the unit taught has been mastered or not by administering the following questions:

i. Explain the following terms as applied to wave motion: i. frequency ii. Cycle iii. Wavelength iv. Amplitude v. Period

Enrichment activities: The teacher engages the students that achieved mastery of unit taught by administering them the following question:

1. Derive the mathematical relationship between: i. frequency and period ii. Frequency and wavelength

Corrective activities: The teacher assists the students that have not achieved mastery of unit taught to re-teach the unit. They may identify alternative learning resources such as

different textbooks, alternative materials or they may simply suggest sources of additional practice.

Formative assessment B: The teacher re-assesses the students that receive remediation to find out whether the unit has been mastered.

LESSON PLAN FOR EXPERIMENTAL GROUP (MASTERY LEARNING)

WEEK FOUR

Subject: Physics
Topic: Properties of waves
Group: Experimental
Class: SSII
Age: 16 years
Sex: Co-education (Mixed)
Teaching Method: Discussion method
Duration: 120min
Instructional Material: Text books
Objectives: By the end of this lesson, the student should be able to:

i. state the properties of waves,

ii. Explain refraction and Polarization, and

iii. Differentiate between angle of incidence and angle of reflection

Previous Knowledge: The students have learned about some terms associated with wave.

Introduction: The teacher introduces the lesson by asking students some questions based on their previous knowledge.

Example:

Explain the following terms:

a. Amplitude

b. Frequency

c. Wave length

d. Period

Presentation:

Teacher's Activities	**Students' Activities**
The teacher shares the class into Five groups A, B, C, D and E. He share the topics to the groups as follows: A: What is refraction	**Step 1:** The teacher share the textbooks to the groups and assign a topic to each of the groups with a group leader. **Step 2:** The teacher asks the students to

B: what is reflection? C: what is interference? D: what is diffraction? E: What is Polarization?	discuss or interact on the topic assign to their group with the group leaders leading the groups for. **Step 3:** The teacher asks the students starting from group A to group E on what they learn while interacting with one another during the group discussion. Students' responses are rewarded. **Step 4:** The teacher make input on students' response. **Step 5:** The teacher asks the students to share their experience during discussion.

Formative assessment A: The teacher assesses the unit taught by administering the following questions to the students:

1. Explain any three of the following properties of waves:
   i. Reflection ii. Refraction iii. Diffraction iv. Polarization v. interference

Enrichment activities: The teacher engages the students that achieved mastery of unit taught by administering the following question:

Distinguish between:

i. Reflection and refraction
ii. Interference and polarization

Corrective activities: The teacher assists the students that have not achieved mastery of unit taught to re-teach the unit. They may identify alternative learning resources such as different textbooks, alternative materials or they may simply suggest sources of additional practice.

Formative assessment B: The teacher re-assesses the students that receive remediation to find out whether the unit has been mastered.

LESSON PLAN FOR EXPERIMENTAL GROUP (MASTERY LEARNING)

WEEK FIVE

Subject: Physics
Topic: Reflection of Light waves
Group: Experimental
Class: SSII
Age: 16 years
Sex: Co-education (Mixed)
Teaching Method: Discussion Method
Duration: 120min
Instructional Material: Text books
Objectives: By the end of this lesson, the student should be able to:

i. List different sources of light waves

ii. Differentiate between rays and beam of light.

iii. Determine the angle of reflection for a given angle of incidence.

iv. Demonstrate a simple experiment to show how light travels in a straight line.

iv. State the laws of reflection

Previous Knowledge: The students have learned about types of wave.

Introduction: The teacher introduces the lesson by asking students some questions based on their previous knowledge.

Example:

Explain the following terms:

a. Reflection

b. Polarization

c. Interference

d. Refraction

e. Diffraction

\ Student are rewarded or motivated for responding to questions

Presentation:

Teacher's Activities	**Students' Activities**
The teacher shares the class into Four groups A, B, C and D. He share the topics to the group as follows: A: what are the sources of light and their examples? B: Rays and beam of light C: Reflection of light at plane surfaces D: Laws of reflection?	**Step 1:** The teacher share the textbooks to the groups and assign a topic to each of the groups with a group leader. **Step 2:** The teacher asks the students to discuss or interact on the topic assign to their group with the group leaders leading the groups. **Step 3:** The teacher asks the students starting from group A to group E on what they learn while interacting with one another during the group discussion. Students' responses are rewarded. **Step 4:** The teacher make input on students' response. **Step 5:** The teacher demonstrates an experiment to show the rectilinear propagation of wave (how light travels in a straight line).

Formative assessment A: The teacher assesses the students to find out whether the unit taught has been mastered or not by administering the following questions:

i. List the different sources of light
ii. Differentiate between a ray and a beam of light

Enrichment activities: The teacher engages the students that achieved mastery of unit taught by administering the following question:

1. Demonstrate a simple experiment to show how light travels in a straight line

Corrective activities: The teacher assists the students that have not achieved mastery of unit taught to re-teach the unit. They may identify alternative learning resources such as different textbooks, alternative materials or they may simply suggest sources of additional practice.

Formative assessment B: The teacher re-assesses the students that receive remediation to find out whether the unit has been mastered.

LESSON PLAN FOR EXPERIMENTAL GROUP (MASTERY LEARNING)

WEEK SIX

Subject: Physics
Topic: Simple calculation on waves
Group: Experimental
Class: SSII
Age: 16 years
Sex: Co-education (Mixed)
Teaching Method: Discussion method
Duration: 120min.
Instructional Material: Text books
Objectives: By the end of this lesson, the student should be able to:

i. State some formulas of waves

ii. Apply the formulas in solving some mathematical problems on waves

The teacher rewards students' response to questions.

Previous Knowledge: The students have learned about light and sound waves.

Introduction: The teacher introduces the lesson by asking students some questions based on their previous knowledge.

Example:

a. List different sources of light waves.

b. Differentiate between a ray and beam of light.

c. State the laws of reflection.

d. Differentiate between regular and diffuse reflection.

Presentation: The teacher presents the lesson through the following steps:

Step I: Some useful formulas on waves

Example:

i. $Y=A \sin\frac{2\pi x}{\lambda}$

ii. $V=f\lambda$

Where v= velocity. F= frequency, λ= wave length.

Step II: Some mathematical problems on waves:

Example 1:

A plane progressive wave is represented by the equation y= sin (200πr- 0.5x). what is the frequency of the wave?

Solution:

Y = Asin ($\frac{2\pi x}{\lambda} - 2\pi ft$)

Comparing the above with the given equation,

Y = 2sin ($2000\pi t - 0.5x$)

We have that:

$2\pi ft = 2000t$

Or $2ft = 2000t$

f = 1000Hz

Step III The teacher gives the students a group work to solve

Example 2:

A radio broadcasts at frequency of 300 kHz. If the speed of the wave is $3x10^8$m/s, calculate the period and wave length of the wave.

Solution

T= $\frac{1}{f} = \frac{1}{3\ x\ 10^5}$ m/s

T= $3.3x10^{-6}$sec

$\lambda = \frac{v}{T} = \frac{3\ x\ 10^8}{3\ x\ 10^5}$m, λ= 1000m = 1km

Formative assessment A: The teacher assesses the students to find out whether the unit taught has been mastered or not by administering the following questions:

1. A light wave of frequency 6.00 $\times 10^{14}$Hz is passed through a liquid. Within the liquid, the wavelength is measured and found to be 3.00 $\times 10^{-7}$m. Calculate the speed of light.
2. The speed of an electromagnetic wave is 3.0 $\times 10^8$$ms^{-1}$ and its wavelength is 2.0×10^2m; calculate the frequency of the wave generator.

Enrichment activities: The teacher engages the students that achieved mastery of unit taught by administering the following question:

The equation y= 4sin (3$\varkappa$+3t)

Where y is in millimeters, $\varkappa$ is in meters, and t is in seconds, represents a plane progressive wave. Determine the:

i. Amplitude ii. Frequency iii. Period, and iv. Speed of wave

Corrective activities: The teacher assists the students that have not achieved mastery of unit taught to re-teach the unit. They may identify alternative learning resources such as different textbooks, alternative materials or they may simply suggest sources of additional practice.

Formative assessment B: The teacher re-assesses the students that receive remediation to find out whether the unit has been mastered.

APPENDIX VI

LESSON PLAN FOR CONTROL GROUP (LECTURE METHOD)

WEEK ONE

Subject: Physics
Topic: Wave
Group: Control
Class: SSII
Average age: 16 years
Sex: Mixed
Teaching Method: Lecture Method
Duration: 80 minutes
Instructional Material: Text book
Objectives: By the end of this lesson the students should be able to:

i. Define the terms wave.
ii. State an example of waves.

Prior Knowledge: Students are aware of some changes that naturally occurred in the environment such as season, day, night etc.

Introduction: The teacher introduces is the lesson by asking students questions based on their previous knowledge. Example, what do you observe when you drop a stone inside a big container with water or a pond? Do you notice a pool of water ahead of you as you walk or travel along a tarmac road on a hot day? If yes, what happen to the pool as you move closer?

Presentation: The teacher presents his lesson based on the following steps:

Step I: The teacher defined wave and wave motion.
Step II: The teacher gives some example of waves
Evaluation: The teacher evaluates the lesson by asking learners the following questions:

i. Who can define wave?
ii. Who can define wave motion?
iii. State 3 example of wave

Conclusion: The teacher concludes his lesson by presenting a summary of the lesson while students copy in their book.

LESSON PLAN FOR CONTROL GROUP (LECTURE METHOD)
WEEK TWO

Subject: Physics
Topic: Types of wave
Group: Control
Class: SSII
Age: 16 years
Sex: Co-education (Mixed)
Teaching Method: Lecture Method
Duration: 80 Minutes
Instructional Material: Text book, chalk board
Objectives: By the end of the lesson, the students should be able to:

i. State the types of waves
ii. Explain each type of wave stated in (i)
iii. State at least two example of each type of wave stated in (i)

Prior Knowledge: The students had been taught on wave which leads to the current lesson.

Introduction: The teacher begins the lesson by asking students questions on their previous knowledge. Example, what is wave? What are the examples of waves?

Presentation: The teacher presents his lesson based on the follow steps:

Step I: The teacher states the types of waves.

Step II: The teacher explains the types of waves.

Step III: the teacher enumerate some examples of each type of wave.

Evaluation: The teacher evaluates the lesson by asking learners the following questions.

i. Who can state the types of waves we have?
ii. Explain any one type of wave.
iii. State two example of each type?

Conclusion: The teacher presents the summary of the lesson on the chalk board while the students copy in to their books.

LESSON PLAN FOR CONTROL GROUP (LECTURE METHOD)
WEEK THREE

Subject: Physics
Topic: Terms associated with wave concept
Group: Control
Class: SSII
Age: 15-16 years
Sex: Co-education (Mixed)
Teaching Method: Lecture Method
Duration: 80 Minutes
Instructional Materials: text book, chalk board.
Objectives: By the end of this lesson, the student should be able to:

i. Explain the terms associated with wave concept such as:
   a. Cycle
   b. Frequency
   c. Wave length
   d. Period

ii .State the relationship between frequency, wave length and velocity.

Previous Knowledge: The learners were taught about types of wave.

Introduction: The teacher introduces the lesson by asking students some question based on their previous knowledge..

Presentation: The instructor presents the lesson through the following steps.

Step I: The teacher explained the following terms.
   (a) Amplitude
   (b) Cycle
   (c) Frequency
   (d) Wave length
   (e) period

Step II: The teacher shows the relationship between frequency, wavelength and velocity.

Velocity= frequency x wave length

$V = f \times \lambda$

Evaluation: The teacher evaluates the lesson by asking learners the following questions:

i. Explain the following:
   (a) Cycle
   (b) Frequency
   (c) Wave length

(d) Period

ii. What is the mathematical relationship between frequency, wave length and velocity

Conclusion: The teacher concludes the lesson by summarizing the major point of the lesson for the students to copy on the chalk board.

LESSON PLAN FOR CONTROL GROUP (LECTURE METHOD)
WEEK FOUR

Subject: Physics
Topic: Properties of Wave
Group: Control
Class: SSII
Average age: 16 years
Sex: Co-education (Mixed)
Teaching Method: Lecture Method
Duration: 80 Minutes
Instructional Material: text book, chalk board.
Objectives: By the end of this lesson, the student should be able to:

a. State the properties of wave
b. Explain the properties of wave.
c. Differentiate between angle of incidence and angle of reflection.

Previous Knowledge: The learners were taught on terms associated with wave concept.
Introduction: The teacher introduces the lesson by asking students some question based on their previous knowledge.
Presentation : The teacher presents the lesson through the following steps.
Step I: The teacher list the properties of wave which include:

i. Reflection
ii. Refraction
iii. Interference
iv. Diffraction
v. polarization

Step II: The teacher explained the properties of wave listed above.
Step III: The teacher differentiates between angle of incidence and angle of reflection.
Evaluation: The teacher evaluates the lesson by asking learners the following questions:

i. State the properties of wave
ii. Explain the properties of wave
iii. Differentiate between incidence angle and angle of reflection.

Conclusion: The teacher concludes the lesson by summarizing the major point of the lesson for the students to copy on the chalk board.

LESSON PLAN FOR CONTROL GROUP (LECTURE METHOD)
WEEK FIVE

Subject: Physics
Topic: Reflection of light wave
Group: Control
Class: SSII
Average age: 16 years
Sex: Co-education (Mixed)
Teaching Method: Lecture Method
Duration: 80 Minutes
Instructional Material: text book, chalk board.
Objectives: By the end of this lesson, the student should be able to:

a. List different sources of light waves.

b. Differentiate between a ray and beam of light.

c. State the laws of reflection.

d. Differentiate between regular and diffuse reflection.

Previous Knowledge: Properties of wave

Introduction: The teacher introduces the lesson by asking students some question based on their previous knowledge.

Example:

a. State the properties of wave

b. Explain at least two of the properties stated

c. What is the difference between angle of reflection?

Presentation: The teacher presents the lesson through the following steps.

Step I: Sources of light:

i. Natural: sun, stars, moon
ii. Artificial: candle, lamp, electric light, torch light.

Step II: The teacher explains:

i. Ray of light
ii. Beam of light
iii. Types of beams of light

Step III: The teacher explains how light is been propagated

Step IV The teacher explains the difference between regular and diffuse reflection and also state the laws of reflection

Evaluation: The teacher evaluates the lesson by asking learners the following questions:

i. List the different sources of light

ii. What is a ray and beam of light?

iii. Differentiate between regular and diffuse reflection?

iv. Explain how light travels in a straight line.

Conclusion: The teacher concludes the lesson by summarizing the major point of the lesson for the students to copy on the chalk board.

LESSON PLAN FOR CONTROL GROUP (LECTURE METHOD)
WEEK SIX

Subject: Physics
Topic: Simple Calculations on waves
Group: Control
Class: SSII
Average age: 16 years
Sex: Co-education (Mixed)
Teaching Method: Lecture Method
Duration: 80 Minutes
Instructional Material: text book, chalk board.
Objectives: By the end of this lesson, the student should be able to:

a. Write some formulas associated with waves
b. Apply the formulas in soling some mathematical problems o waves.

Previous Knowledge: Light and sound waves

Introduction: The teacher introduces the lesson by asking students some questions based on their previous knowledge.

Example:

a. list different sources of light
b. State the characteristic of sound wave
c. Draw ray diagrams to show the formation of plane mirror

Presentation: The teacher presents the lesson through the following steps.

Step I: Some useful formulas on waves

Example:

iii. $Y=A \sin\frac{2\pi x}{\lambda}$
iv. $V=f\lambda$

Where v= velocity. F= frequency, λ= wave length.

Step II: Some mathematical problems on waves:

Example 1:

A plane progressive wave is represented by the equation y= sin ($200\pi r$- 0.5x). What is the frequency of the wave?

Solution:

$Y = A\sin\left(\frac{2\pi x}{\lambda} - 2\pi f t\right)$

Comparing the above with the given equation,

$Y = 2\sin(2000\pi t - 0.5x)$

We have that:

$$2\pi f t = 2000t$$

Or $2ft = 2000t$

f = 1000Hz

Example 2:

A radio broadcasts at frequency of 300 kHz. If the speed of the wave is $3x10^8$m/s, calculate the period and wave length of the wave.

Solution

$T = \frac{1}{f} = \frac{1}{3\ x\ 10^5}$ m/s

$T = 3.3x10^{-6}$sec

$\lambda = \frac{v}{T} = \frac{3\ x\ 10^8}{3\ x\ 10^5}$m, λ= 1000m = 1km

Example:

The frequency of vibrating a source is 450Hz and the velocity of the sound it produces in air is $330ms^{-1}$. Find how far the sound travels when the source completes 50 vibrations.

Solution:

time for 50 oscillation is given by

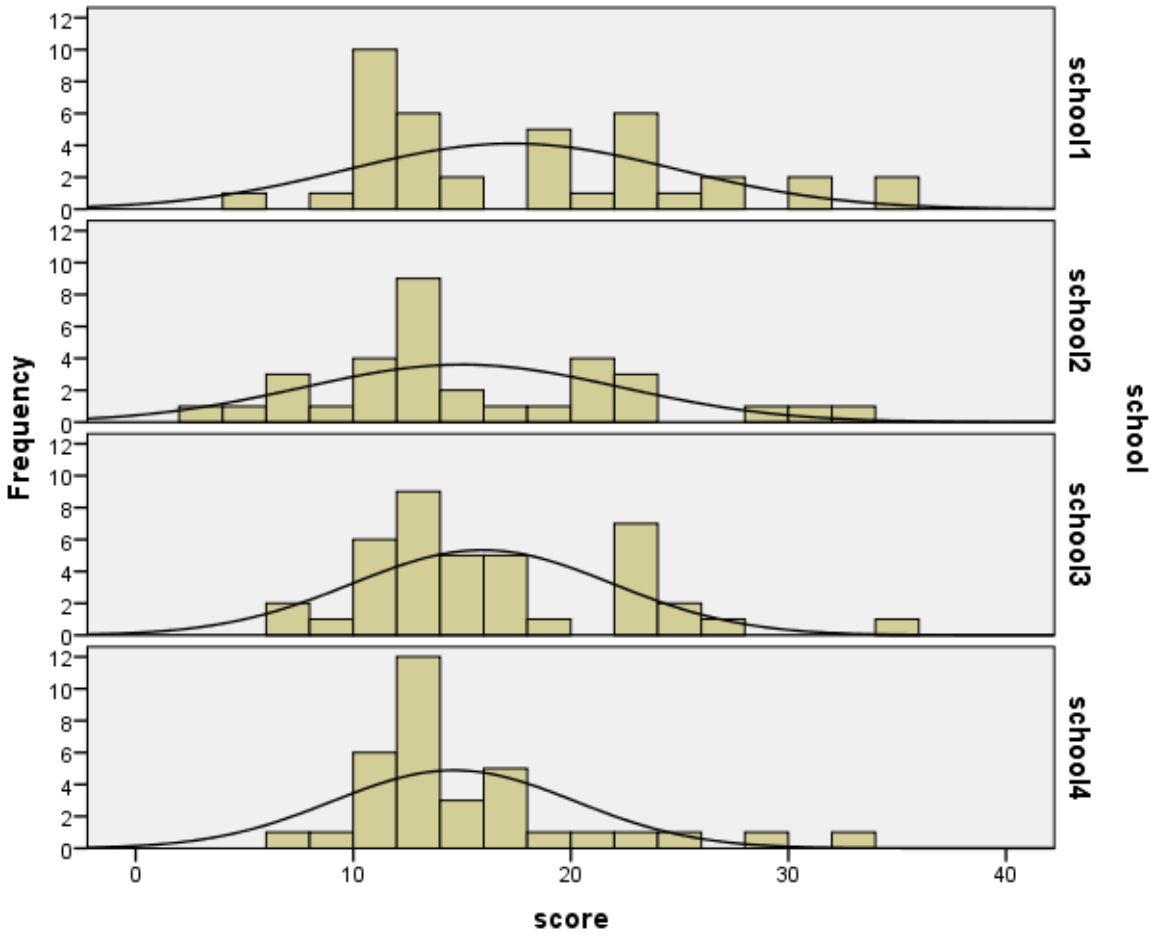
$t = \frac{1}{f} = \frac{1}{450} = \frac{1}{9}$ sec

$s = vt, 330\ x\ \frac{1}{9} = 36.67$m

Evaluation: The teacher evaluates the lesson by asking learners some questions based on what he taught them.

Conclusion: The teacher concludes the lesson by summarizing the major point of the lesson for the students to copy on the chalk board

APPENDIX VII



```
NPAR TESTS
  /K-W=score BY school(1 4)
  /MISSING ANALYSIS.
```

NPar Tests

```
[DataSet1] C:\Users\umar\Documents\Mustapha Sani Bichi2.sav
```

Kruskal-Wallis Test

Ranks

	School	N	Mean Rank
score	1 school1	39	79.58
	2 school2	33	68.11
	3 school3	40	77.11
	4 school4	34	67.51
	Total	146	

Test Statistics[a,b]

	Score
Chi-Square	2.339
Df	3
Asymp. Sig.	.505

a. Kruskal Wallis Test

b. Grouping Variable: school

```
UNIANOVA score BY school
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /EMMEANS=TABLES(school) COMPARE ADJ(LSD)
  /PRINT=ETASQ HOMOGENEITY DESCRIPTIVE
  /CRITERIA=ALPHA(.05)
  /DESIGN=school.
```

Univariate Analysis of Variance

[DataSet1] C:\Users\umar\Documents\Mustapha Sani Bichi2.sav

Between-Subjects Factors

		Value Label	N
School	1	school1	39
	2	school2	33
	3	school3	40
	4	school4	34

Descriptive Statistics

Dependent Variable: score

School	Mean	Std. Deviation	N
1 school1	17.31	7.564	39
2 school2	15.00	7.297	33
3 school3	15.93	5.980	40
4 school4	14.62	5.549	34
Total	15.78	6.668	146

Levene's Test of Equality of Error Variances[a]

Dependent Variable: score

F	df1	df2	Sig.
2.892	3	142	.038

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + school

Tests of Between-Subjects Effects

Dependent Variable:score

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	157.874[a]	3	52.625	1.188	.317	.024
Intercept	35794.806	1	35794.806	808.200	.000	.851
School	157.874	3	52.625	1.188	.317	.024
Error	6289.112	142	44.290			
Total	42806.000	146				
Corrected Total	6446.986	145				

a. R Squared = .024 (Adjusted R Squared = .004)

Estimated Marginal Means school

Estimates

Dependent Variable:score

school	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1 school1	17.308	1.066	15.201	19.414
2 school2	15.000	1.158	12.710	17.290
3 school3	15.925	1.052	13.845	18.005
4 school4	14.618	1.141	12.361	16.874

Pairwise Comparisons

Dependent Variable:score

(I) school	(J) school	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a] Lower Bound	Upper Bound
1 school1	2 school2	2.308	1.574	.145	-.804	5.419
	3 school3	1.383	1.498	.357	-1.578	4.343
	4 school4	2.690	1.561	.087	-.397	5.777
2 school2	1 school1	-2.308	1.574	.145	-5.419	.804
	3 school3	-.925	1.565	.555	-4.019	2.169
	4 school4	.382	1.626	.814	-2.832	3.597
3 school3	1 school1	-1.383	1.498	.357	-4.343	1.578
	2 school2	.925	1.565	.555	-2.169	4.019
	4 school4	1.307	1.552	.401	-1.761	4.376
4 school4	1 school1	-2.690	1.561	.087	-5.777	.397
	2 school2	-.382	1.626	.814	-3.597	2.832
	3 school3	-1.307	1.552	.401	-4.376	1.761

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Dependent Variable:score

	Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Contrast	157.874	3	52.625	1.188	.317	.024
Error	6289.112	142	44.290			

The F tests the effect of school. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

Items Analysis of PAPT Test Items

S/NO.	A	B
	F.I. = $\frac{U+L}{N}$	$\mathbf{D_1}$ = $\frac{Ru-Ri}{\frac{1}{2}N}$
1	0.54	0.63
2.	0.57	0.60
3.	0.67	0.68
4.	0.54	0.70
5.	0.51	0.58
6.	054	0.45
7.	0.64	0.67
8.	0.66	0.68
9.	0.58	0.71
10.	0.70	0.65
11.	0.83*	0.81
12.	0.56	0.65
13.	0.65	0.70
14.	0.55	0.58
15.	0.70	0.59
16.	0.45	0.59
17.	0.70	0.69
18.	0.56	0.65
19.	0.67	0.43
20.	0.17*	0.67
21.	0.69	0.17
22.	0.64	0.58
23.	0.65	0.68
24.	0.62	0.77
25.	0.61	0.52
26.	0.42	0.70
27.	0.75*	0.54
28.	0.65	0.58
29.	0.66	0.65
30.	0.55	0.67
31.	0.54	0.62
32.	0.56	070
33.	0.86*	0.65
34.	0.67	0.82
35.	0.45	0.65
36.	0.63	0.64
37.	0.65	0.55
38.	0.59	0.58
39.	0.51	0.67
40.	0.61	0.70